SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1937

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PREFACE

The present pamphlet is intended as a preliminary announcement of Smithsonian field expeditions during the calendar year 1937. A large percentage of the Institution's researches are concerned with the sciences of geology, biology, and anthropology, and in these sciences field-work plays an important rôle. Many investigations in the natural sciences depend largely upon data which can only be obtained through actual work in the field. Such expeditions are necessary also to fill in gaps in the study collections of the National Museum, which form the basis for much of the Institution's research.

Some of the expeditions herein described were financed wholly by the Institution, but others were cooperative undertakings with other organizations interested in the promotion of the same sciences. The technical results of these expeditions and of the investigations to which they relate will later appear in one of the other series of publications issued by the Institution and two of its branches, the National Museum and the Bureau of American Ethnology.

W. P. True, *Editor.*

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FOSSIL HUNTING IN UTAH AND ARIZONA

By CHARLES W. GILMORE

Curator of Vertebrate Paleontology, U. S. National Museum

The 1937 Smithsonian Paleontological Expedition for fossil vertebrates had as its main objective the exploration of certain geological formations that occurred on and around North Horn Mountain in central Utah. This area had been brought to our attention by members of the U. S. Geological Survey because of the fact that some 1,650 vertical feet of beds originally mapped as Wasatch, Eocene, were later found to carry fragmentary dinosaur and mammalian fossils. The hope of obtaining identifiable specimens that would accurately date these deposits and also the hope of opening up a new field for horned and other dinosaurian specimens were the motives which actuated this undertaking.

The party, consisting of Messrs. George F. Sternberg and George B. Pearce under the direction of the writer, established camp at the Olsen Ranch in "Joes Valley" in the Manti National Forest on June 15. On the following day under the guidance of Dr. E. M. Spieker, of Ohio State University, who had mapped the geology of the region and was therefore conversant with all aspects of the field, collecting was begun.

On the very first day Pearce made the amazing discovery of an articulated skeleton of a very large sauropodous dinosaur, a totally unexpected find in an Upper Cretaceous formation in which also occurred the remains of ceratopsian dinosaurs. Only once before has such an association been found, and that in the San Juan Basin in New Mexico, where Dr. John B. Reeside, Jr., in 1921 found the type specimen of *Alamosaurus sanjuanensis* Gilmore, which the present specimen appears to resemble closely. Although subsequent study may modify such a conclusion, the inference at present is that these Utah deposits containing dinosaurian remains on North Horn Mountain are equivalent in age to those in New Mexico.

The *Alamosaurus* skeleton was found in a badland area at the south end of North Horn Mountain. It was lying on its back with the anterior part of the skeleton projecting from the outcrop. The head and neck had long since been eroded away and destroyed. The dorsal series, owing to its proximity to the surface, was so soft and disintegrated as to be valueless and therefore was not collected. The left fore limb and foot in the articulated position as found (fig. 2) measured 9 feet in length, which gives some idea of the great size of

FIG. 1.—Camp at Olsen ranch in Joes Valley, Emery County, Utah. (Photograph by G. F. Sternberg.)

FIG. 2.—Articulated skeleton of sauropod dinosaur partly uncovered as it lay in the ground. (Photograph by G. F. Sternberg.)

FIG. 3.—Plastered blocks of sauropod skeleton. North Horn Mountain in the background. (Photograph by G. F. Sternberg.)

FIG. 4.—Hauling bones of sauropod dinosaur. (Photograph by G. F. Sternberg.)

the individual. In the 3 weeks of continuous work required to excavate and prepare the bones for shipment to the National Museum about one-third of the skeleton was recovered.

Another specimen found in these same deposits, also worthy of special mention, is the disarticulated skull and parts of skeleton of a horned dinosaur. When the scattered elements are prepared and assembled it is estimated the skull will have a length of more than 6 feet. It appears to represent a form new to science, and further interest attaches to this discovery as it greatly extends the western geographical range of the Ceratopsia in North America.

Later in the season special search was made of the overlying beds, in which a single skull fragment of a mammal had previously been found by Messrs. Reeside and Spieker. This work was rewarded by the recovery of a small collection of identifiable skull and jaw fragments carrying teeth, which was sufficient to indicate definitely for the first time the Paleocene age of this part of the geologic section.

Just as the season drew to a close in this area, the discovery of six more or less complete articulated skeletons of a small lizard made a fitting climax to our explorations. These lizard specimens represent an undescribed form, and they so thoroughly supplement one another that a knowledge will be gained of practically the entire skeletal anatomy. These specimens are among the oldest lizards known from North America and the most perfectly preserved of any yet discovered.

The work of collecting in this area, especially of dinosaurian remains, was particularly arduous. The steepness of the exposures, the 8,000-feet elevation, and the inaccessibility of much of the terrain to the motor car, added much manual labor to the collector's task.

On August 1, after having boxed and shipped the collections made, we proceeded by motor from Price, Utah, to Holbrook, Ariz., where according to our original plan for the season's work, 3 weeks were spent in the exploration of the Chinle division of the Triassic for its fossil vertebrates.

Here most of our work was in the badland areas bordering the Petrified Forest. Our work here was greatly facilitated by the generous assistance given by Ranger Naturalist M. V. Walker of the National Park Service. In the short time at our disposal we were fortunate in accumulating a representative collection from the Chinle, material that was badly needed to round out the Triassic part of the paleontological collections of the National Museum. Three phytosaur and two stegocephalian skulls are worthy of special mention.

In all, the specimens collected on this expedition filled 13 large cases, which had a combined weight of 5,729 pounds.

THE CAMBRIAN ROCKS OF NEW YORK, VERMONT, AND QUEBEC

By CHARLES E. RESSER

Curator, Division of Invertebrate Paleontology, U. S. National Museum

Cambrian rocks were studied during the past field season in New York, Vermont, and Quebec, and the work was doubly interesting because it was done in very attractive portions of America. On the way to the first objective in the Adirondack Mountains, Cambrian outcrops in central Pennsylvania were briefly studied. Folds and faults here bring up old rocks, exposing a sequence which matches that of the southern Appalachians and which constitutes the most northerly outcrops of the older Paleozoic beds west of the Appalachian Valley.

The first objective of the season was examination of the Potsdam and related Cambrian formations on the flanks of the Adirondack Mountains. During Upper Cambrian times marine waters entering the continent surrounded an old rock mass, now the Adirondacks. These present uplands were then evidently low islands in the Cambrian sea. Today the Cambrian formations flank the mountains on the northern and eastern sides but are absent by overlap of younger strata on the south and west. However, the outcrops do not form a continuous belt around the mountains as they must have when deposited. Inliers show that formerly the Cambrian beds extended much farther in toward the center of the mountain mass than they do now. Radial faults, possibly formed during the building of the Appalachian Mountains to the east, separated the margins of the Adirondacks into blocks, which were moved up or down with respect to each other. The down-dropped blocks were protected from the full force of erosion agents, particularly recent glaciation, and hence retain the layers of Cambrian rocks. At many places glacial drift covers large areas. Through removal of the Cambrian beds in some areas and covering by glacial drift in others, only isolated patches of the rocks remain for study.

Fossils are rare in the sandstones which comprise much of the Cambrian sequence and which rest on the granitic foundation of the Adirondacks. These sandstones grade upward into calcareous beds. Since the calcareous material is chiefly magnesium, the rocks are dolomite, a type of matrix which seldom preserves fossils.

After the melting of the ice sheets, the streams radiating from the higher portions of the Adirondacks flowed in new channels. Those

FIG. 5.—Ausable Chasm, New York.

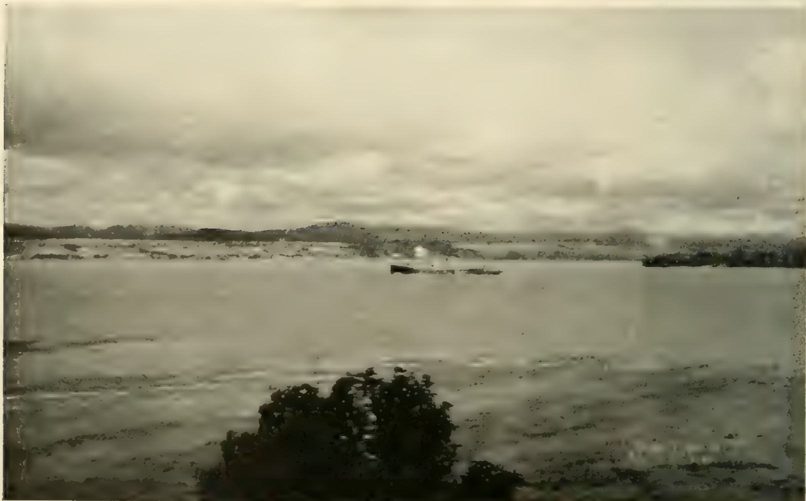


FIG. 6.—St. Lawrence River. Montmorency Falls in center, Laurentian Mountains in background.

FIG. 7.—Trois Pistoles, Quebec.

FIG. 8.—Percé, Quebec from the top of Mount St. Ann.

which had to cross a belt or patch of the sedimentary Cambrian rocks were able to cut valleys rapidly, producing vertical-walled canyons. Most of these are picturesque, the best being Ausable Chasm, annually visited by thousands of people.

A second major objective was study of the Cambrian sequence in northwestern Vermont. Conditions there contrast strongly with those in the Adirondack area across Lake Champlain. The Green Mountains and hills of Vermont belong to the Appalachian Mountain system, hence the rocks are strongly folded and overthrust. In the Adirondack Mountains marine waters first flooded the flanks of the old land mass to deposit Upper Cambrian beds which still remain as more or less horizontal layers. In Vermont, however, the Cambrian sequence begins with the much older Lower Cambrian, and intensive folding and faulting have given both the landscape and the outcrops quite a different aspect. The earth movements altered the limestones and shales into marbles and slates, which in turn gave rise to one of Vermont's chief industries.

The third major objective of the summer's work was study of the Lower Cambrian deposits in the St. Lawrence valley. Outcrops begin at Lévis, directly opposite Quebec City, and extend intermittently along the river for more than 200 miles, as very peculiar occurrences. The rocks are limestones like those in the Straits of Belle Isle, Labrador, but occur here only as boulders in limestone conglomerate. Outcrops of such bedded rock are unknown along this vast stretch of the river. Why and how these deposits came into existence is an unsolved geological problem even though studied for about 100 years.

Some of the limestone pebbles yield excellent fossils, but collecting is difficult because both the pebbles and matrix are composed of limestone so that both disintegrate simultaneously. Fossiliferous pebbles may be seen but, since they are not on the edge of the rock mass, cannot be broken out.

Near the tip of Gaspé Peninsula Cambrian strata have been found in two small areas. These occurrences are intensely folded strata, a continuation of the Appalachian system, and show thereby that the seaways extended the great distance from central Alabama. Percé on the tip of the Gaspé Peninsula is one of the most attractive places in the world. Vertical cliffs of red, cream, and gray rocks, grassy slopes, forested mountains, fish-drying racks, attractive homes, fishing boats, and the sea combine to produce a beautiful picture. For years an artist colony has tried to put some of this beauty on canvas, and travelers are rejoiced by spending a few days at Percé.

COLLECTING FOSSILS IN MICHIGAN, PENNSYLVANIA, NEW YORK, AND CANADA

By G. ARTHUR COOPER

Assistant Curator, Division of Stratigraphic Paleontology, U. S. National Museum

To collect fossils needed in current investigations in the Division of Stratigraphic Paleontology, the writer made three separate field trips during the summer of 1937: a month in Michigan, a week in Pennsylvania, and 2 weeks in the Champlain Valley of New York and southern Canada.

Michigan.—During three previous trips to Alpena and Petoskey the writer studied the strata and collected fossils from Middle Devonian rocks. The month of June was spent in the vicinity of Alpena, Petoskey, and Onaway in an effort to correct suspected errors in stratigraphy and to collect better specimens of certain kinds of fossils. The results of the work were satisfactory in data collected and important additions to the collection.

Pennsylvania.—The Tully formation is a stratum lying at the base of the Upper Devonian. Although this formation and its contained fossils are well known in New York, it is largely through the efforts of Dr. Bradford Willard, of the Pennsylvania Topographic and Geologic Survey, that rocks of Tully age have been identified in Pennsylvania. The writer, because of his familiarity with the New York Tully, was invited by Dr. Willard to examine rocks of this formation in Pennsylvania. A pleasant week was spent with Dr. Willard in tracing this formation from a point near Everett in south-central Pennsylvania northeastward to a point not far south of Pottsville in the east-central part of the State. The Tully outcrop extends from this latter point to Milford near the New York-Pennsylvania line.

Unlike New York, where the Devonian rocks are nearly flat, these strata in Pennsylvania have been thrown into gigantic folds having in general a northeast-southwest trend. The great anticlines and synclines are also complicated by cross-folds, causing the northeast-southwest trending structures to pitch under the surface at places. The outcrops of Devonian rocks thus form elongate and canoe-shaped patterns.

Dr. Willard and the writer started their studies about 40 miles north of the Maryland State line at the settlement of Eichelburgertown. Here the Tully is 3 feet thick and is composed mainly of limestone. The limestone thickens along the Alleghany Front to 35 feet

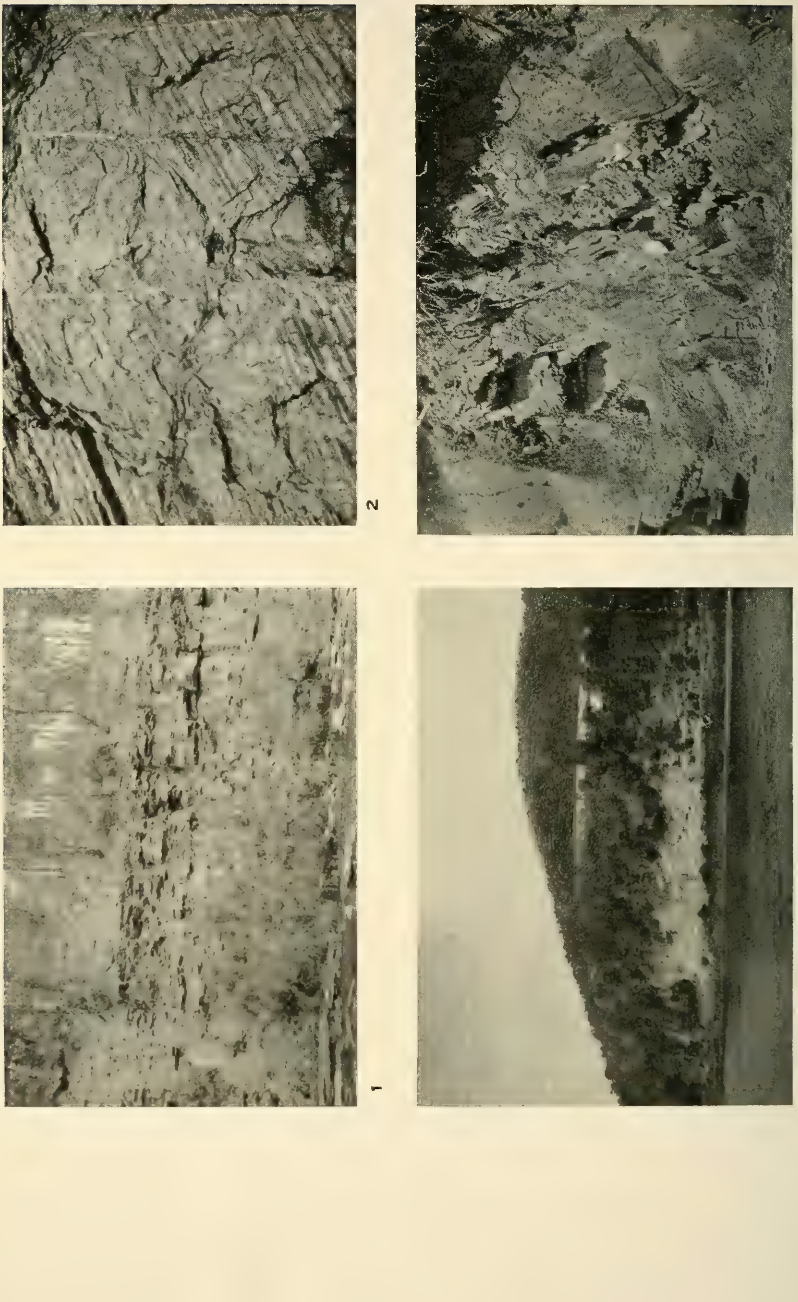


FIG. 9.—1. Bluff of fossiliferous Devonian limestone, Ocqueoc Falls, Presque Isle County, Mich. 2. Ribbon banding in Tully limestone, opposite Lockhaven, Clinton County, Pa. 3. Tully limestone exposure (about 200 feet thick), opposite Lockhaven, Pa. 4. Thinned Tully (between hat and bag), Eichelburgertown, Bedford County, Pa.

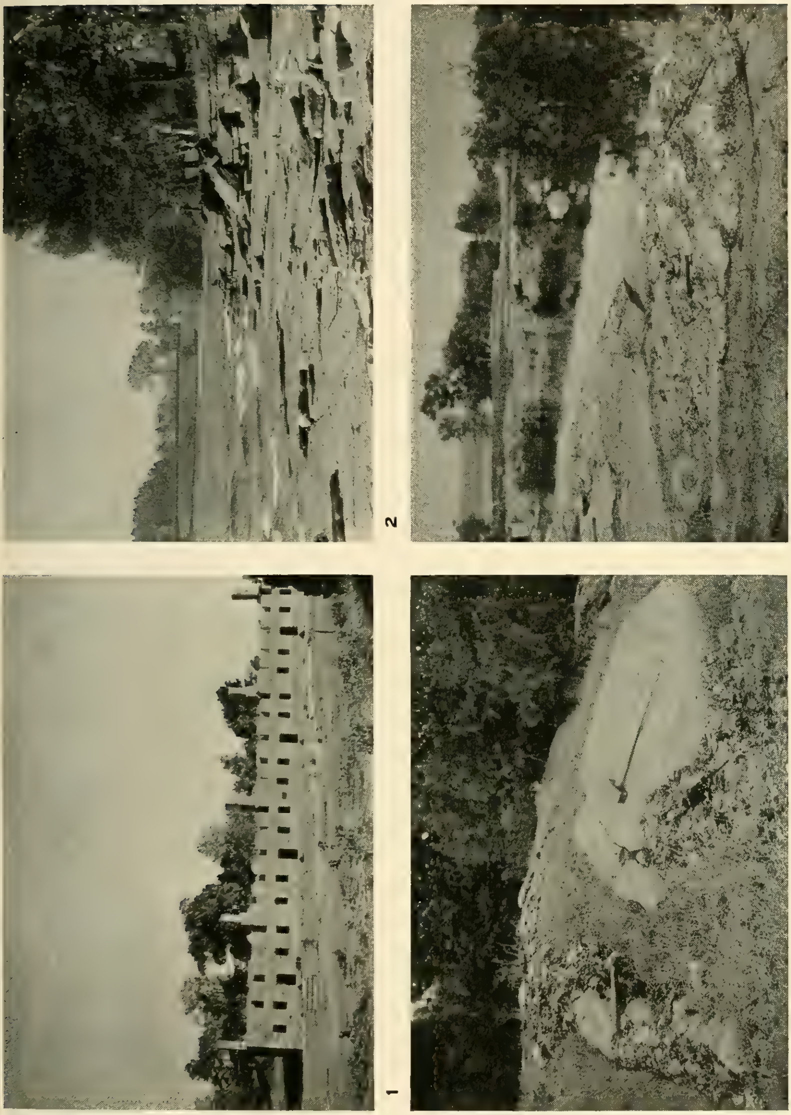


FIG. 10.—1. British Fort at Crown Point, N. Y. Chazy limestone in foreground. 2. Chazy limestone, Day Point, Lake Champlain, N. Y. 3. Large fossiliferous boulder in Mystic conglomerate, near Mystic, Quebec, Canada. 4. Stromatopore reef in Chazy limestone, Cooperville, N. Y.

near Mount Eagle and to nearly 250 feet at Lock Haven. To the east and southwest the limestone thins to 35 feet at Danville and to a few inches near Mandatta. Southwest of this place on the Juniata River, about 30 miles northwest of Harrisburg, the formation is composed of a thin calcareous layer and about 15 feet of shale. Traced eastward from here the lime content disappears and the Tully fauna has been found in shale and sandstone in eastern Pennsylvania. During this investigation a number of good collections were made from this little-known formation and also from the underlying Hamilton rocks.

New York and Canada.—This trip was undertaken with Dr. Josiah Bridge of the United States Geological Survey. The purpose was threefold: to study Ordovician (Chazyan) rocks at their type section, Chazy, N. Y.; to collect fossils from the Mystic conglomerate of southern Quebec; and to study type fossils from the Chazy formation in the National Museum of Canada at Ottawa, Ontario.

1. The Chazy formation is well exposed at its type section in Chazy, N. Y., which lies just below the Canadian border on the shores of Lake Champlain. These rocks are also well exposed at Crown Point, N. Y. In fact the walls of the old French fort and those of the later English fort at Crown Point were built of blocks of this limestone quarried from nearby ledges.

At Chazy the rocks are mostly massive limestones broken into blocks by faults. Nearly the entire sequence is present at Chazy and can be seen just west of the village. Fossils are common, particularly a large flat snail known as *Maclurea*. Collections were made at Chazy and also at Crown Point.

2. From Chazy the party moved to Bedford in southern Quebec. Here occur outcrops of a peculiar conglomerate made of large boulders of limestone containing fossils of different geologic ages. One type of boulder contains fossils related to species found farther south at Phillipsburg, Quebec, and in Vermont. Another type of boulder contains a fauna whose nearest relative is found in Newfoundland. Good collections of peculiar fossils were taken from two large boulders of this latter type.

3. After two days in Bedford the party went on to Ottawa with a short stop at McGill University in Montreal. Between Hawkesbury and Ottawa small collections of Chazyan fossils were made in roadside cuts and quarries. Two days were spent in studying type specimens in the National Museum of Canada. On the return trip to Washington a short stop was made at a large quarry on the Colgate University Campus at Hamilton, N. Y., where a few fine Devonian fossils were collected.

MINERALS OF RUSSIA

By E. P. HENDERSON
Assistant Curator, Division of Physical and Chemical Geology, U. S. National Museum

The International Geological Congress was held in Moscow in 1937, and it was my good fortune to represent the Smithsonian Institution at the meetings. As is customary at these congresses, several pre- and post-congress excursions were offered, and advantage was taken of one of each to see the geology as well as the countryside of Russia. Before the congress I spent a profitable month in visiting the museums and scientific institutions in England, Scotland, Norway, Sweden, and Finland. On June 30, I crossed the Finnish-Russian boundary just one day before the pre-congress excursion departed from Leningrad to the Kola Peninsula, the northernmost point of European Russia.

Now at last I was within a vast country whose language and economic structure differed from any other I had heretofore visited. Being in possession of much advance advice and instruction, yes, even warnings, I found myself always interpreting everything I encountered or experienced in accordance with knowledge gained by someone else. I believe most newcomers to Russia experience this same mental confusion, and it was not until I had been there several days—in fact, about as many days as the average American tourist stays—that I began to see Russia as it really is. I found the Russians easy people to meet and be friendly with, so that even the lack of a common language did not altogether hinder the making of friends or the exchange of many simple courtesies.

The trip to the Kola Peninsula was made by train, supplemented by boat and motor car. The entire trip can be made by train, but it was our wish to see the geology and mineral resources of this country, and many interesting side trips were arranged for us. There are two political subdivisions in this territory, Karelia, and the Murmansk District of the Leningrad Province; much of the latter lies north of the Arctic Circle.

Karelia is essentially a wooded country, about 90 percent of the country being covered with fine timber. Lumbering has been and perhaps will remain for years the principal industry of this district. The mining industry of Karelia, although very young, is growing rapidly. The region is not richly mineralized with metallic deposits, but there are abundant sandstones and igneous rocks which are being extensively used in Leningrad and Moscow for building and paving

Fig. 11.—En route to visit an island in the White Sea.

Fig. 12.—Reworking the platinum placer ground at Nizhny Tagil in northern Ural Mountains.

Fig. 13.—A relic of Old Russia.

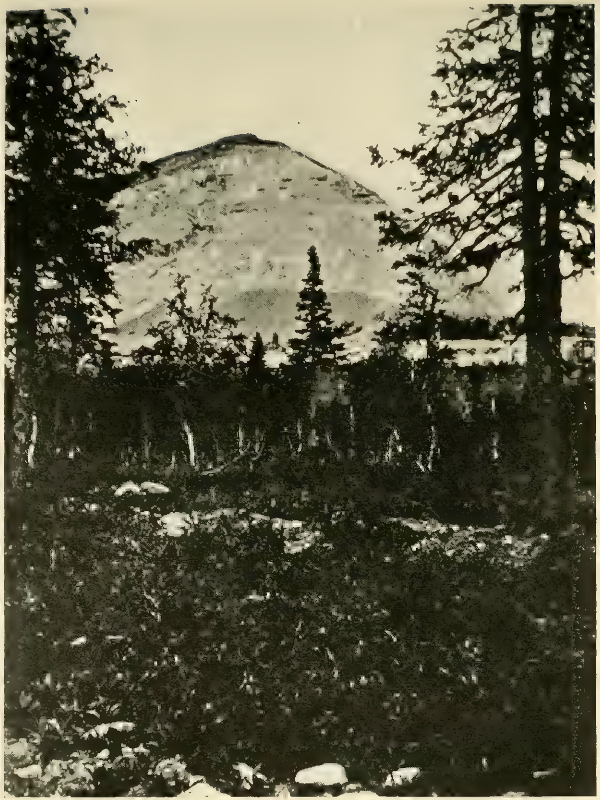


Fig. 14.—The working face of the Kukisvumchorr apatite deposit near Kirovsk, Kola, U. S. S. R. The world's greatest phosphate occurrence.

Fig. 15.—Russian girl pushing a mine car. Women are frequently employed in various arduous duties connected with mining.

stone. After several days in Leningrad one senses the magnitude of the extensive reconstruction work in progress, and since Karelia is the nearest source of essential material, it is only natural that this area will continue to expand and develop its mineral resources.

The general features of Karelia resemble those of Finland; it is essentially a lowland with many lakes, rivers, and marshes. In the northern portion there are some hills 2,000 feet in elevation, but the elevation of the larger portion of the district is less than half that figure, and to the east along the White Sea the country flattens out to a marshy lowland. There are thousands of small lakes and one very large one, Lake Onega, which covers about 10,000 square miles.

North of Karelia lies the Kola district, and although north of the Arctic Circle, it has a comparatively moderate climate. Murmansk, a city of over 100,000 people and the largest town in the Arctic, is the only seaport of Russia on the north that is free from ice all the year round. The water about Leningrad, over a thousand miles to the south, is frozen solidly during the winter. The same warm ocean current that furnishes England, Norway, and Sweden with a mild climate spends almost the last of its warmth keeping ice from forming on this northern shore. Murmansk, therefore, with rich resources of lumber and minerals and with all-year-round access to the open sea, will certainly become an important city.

The mining industry centered around Kirovsk is one of the most recent developments in Russia. There is one of the world's great deposits of phosphate ore, apatite, which is closely connected with the intrusion of the nepheline syenites, and in and around this peculiar igneous complex are many rare minerals, some of them found in rather large quantities. The Soviet geologists have done a large amount of systematic prospecting to uncover these minerals, and the area is a veritable paradise for mineralogists.

Kola Peninsula also supports other important activities. Off shore is a fine fishing ground, and every day trainloads of fish leave the north for the larger cities farther south. The region is by no means a barren, bleak waste as many suppose, but does have agricultural possibilities. We ate potatoes, green vegetables, and strawberries that had been raised on experimental farms and also saw a good herd of dairy cattle grazing in the fields. The country looks promising, especially when visited during the period of 24-hour sunshine. What it is like in winter may be a different story, but the Soviets are making serious efforts to develop the entire area.

Following the northern excursion, several days were spent in Moscow, where the scientific meetings of the Congress were held, and a

FIG. 16.—View of glaciated valley in Khibine Mountain, Kola district, U. S. S. R. The plateau is about 3,000 feet above sea level. Photograph taken in mid July.

FIG. 17.—Bazhenov deposit of asbestos on the east slope of Ural Mountains near Sverdlovsk. A very rich and extensive deposit of high grade asbestos.

FIG. 18.—A typical Russian village street.

special trip was made to Leningrad to visit the museums and institutions. The delegates were well entertained and extended many courtesies not ordinarily given to tourists. To me, even more interesting than the meetings, were the museums and other special exhibits prepared for us. A certain similarity exists among mineral collections in whatever part of the world they are found, but when one first enters a Russian museum he is at once impressed by the many new occurrences of minerals with which the rest of the world is altogether too unfamiliar. The Soviets have been very active geologically and have many prospecting parties out each year. It is only natural, therefore, that such activity should bring to light many fine mineral specimens and new localities.

Of the post-congress excursions, that to the Ural Mountains was the most interesting. The Urals for years have been known as a highly mineralized area, and today their mineral resources are being developed at a greatly accelerated rate. These mountains are not high, nor did we see many peaks, but here is some of the finest scenery of Russia. One approaches the Urals by crossing a long plateau about 1,000 feet in elevation, on which are many vast wheat fields and abundant timber.

The Ilmen Mountains were visited and our respects paid to some of the old classical mineral localities. Chrome, asbestos, talc, magnesite, iron, nickel, coal, and platinum deposits were examined, as well as many local quarry outcrops, and at every locality members of the congress were permitted to collect mineral specimens.

Geologically Russia is the most active country I have ever seen, thousands of geologists and prospectors being in the field each year. It is therefore logical to expect that many new discoveries will be made, as the Soviet Union is one of the largest unexplored and undeveloped areas in the world. The Soviets will consume most of their mineral production in developing their own country and will possibly need to supplement some of their metalliferous production with imports from abroad. Today, however, Russia has asbestos, phosphates, and magnesite in huge quantities to export, as well as some petroleum.

Returning to Moscow from the Ural Mountains, I turned over my collections to the officials for shipment to America and departed for Odessa on the Black Sea. Thence my journey led across the Black Sea, through the beautiful Bosphorus, and on to the Island of Ceylon, where a week was spent visiting the sapphire districts and graphite mines. Finally, before returning to America, I visited Japan, where several weeks were spent in the scientific laboratories and institutions.

WITH THE BIRDS OF NORTHWESTERN VENEZUELA

By ALEXANDER WETMORE
Assistant Secretary, Smithsonian Institution

After a field acquaintance of a year with the birdlife of the southern republics of South America it has long been my desire to make similar studies in the northern part of that great continent. Opportunity for this finally came when on October 16, 1937, I arrived in Caracas, Venezuela. Through the friendly cooperation of the American Minister, Mr. Meredith Nicholson, and the gracious assistance of Dr. E. Gil Borges, Ministro de Relaciones Exteriores of Venezuela, the necessary permissions for travel and for collecting specimens were quickly arranged. The Minister of the Departmento de Agricultura y Cria, Sr. H. Parra Pérez, and the Director de Tierras Baldias, Bosques y Aguas, Sr. Miguel Parra Sánoja of the same department, were deeply interested in my proposed studies and afforded the fullest cooperation.

Field-work began at Maracay on October 21 in company with Mr. Ventura Barnés, who accompanied me on many days afield and whose knowledge of local conditions was invaluable. The following day Dr. Henri Pittier, the veteran botanist, strong and active at the age of 80, took me into the great Parque Nacional recently established by the Venezuelan Government as a wild life reserve.

Beginning near Guamitas 14 kilometers northwest of Maracay, this huge reservation extends over the mountain range of the Cordillera de la Costa, and down across the northern lowlands to the sea. The far-sighted policy on the part of the Government in establishing this park at the present time must have the highest commendation of all interested in conservation since it will preserve for the future areas of forest and other natural resources that would otherwise have been lost forever through commercial exploitation.

My quarters here were first in a house belonging to the Department of Agriculture, located back of the beach near Ocumare de la Costa. Rocky headlands extended into the sea on either side, and a rushgrown lagoon lay back of the wave-washed sands of the beach. Inland a level, open plain led to steep, rocky hills, grown with huge cacti and thorny shrubs.

The open brush swarmed with birds, abundant not only individually but with great variety in species. Tiny hummingbirds, brilliant green in color, and yellow-breasted honey creepers swarmed about the deli-

Fig. 19.—Dr. Henri Pittier, the botanist (at right), with the author at Independencia, near Ocumare de la Costa. October 24, 1937.

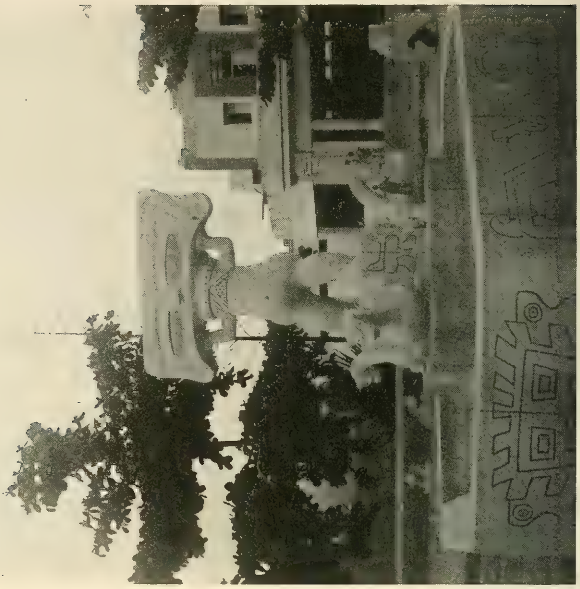


Fig. 20.—A modern fountain in the interesting Plaza Indigena de Tacarigua, near Maracay. November 1, 1937.

FIG. 21.—Shore of the lagoon near Ocumare de la Costa, with the rest house on the beach in the background. October 25, 1937.

FIG. 22.—A view of the mountains near Rancho Grande, from the shore of the lagoon at Ocumare de la Costa. October 27, 1937.

cate, scented flowers of small mimosas. Curious flycatchers of many species, ranging from those half the size of a chickadee to the robust Derby flycatcher as large as a robin, frequented the open forest or its brushy borders. Small pigeons flew up on every hand as I traveled the cattle trails, and occasionally I came across long-billed jacamars or stolid puff-birds resting quietly on open limbs.

Excursions in the hilly country toward the base of the mountains took me into more humid sections with dense, green plant growth in whose somber shades lived short-tailed woodland wrens, brown wood-hewers—perching birds with stiffened tail-feathers that climb on trees like woodpeckers—hummingbirds, tanagers, brilliant manakins with black breasts, red crowns, and light blue backs, and many other interesting birds.

The lagoon was always attractive, with its groups of long-toed jaçanas that walked about on the grassy banks like chickens, its tiny grebes that floated on its surface, and its herons and egrets that waded in its shallows. Red-breasted vermilion flycatchers frequented trees on its borders, and white-breasted marsh flycatchers (*Fluvicola pica*) hawked like swallows over its surface.

While the native birds were always strange and curious I found equal interest in the many migrants from North America that during the latter part of October were arriving daily from their long flight across the Caribbean sea for a winter in the Tropics. Barn swallows rested on wires or cruised for insects over the open plain, black-poll warblers, redstarts, and an occasional black-throated blue warbler came into trees near the house or were found in the brush inland, and flocks of pectoral, white-rumped, and Baird's sandpipers, en route from nesting grounds near the Arctic Circle to a winter home in Patagonia, ranged over the muddy shallows of the lagoon. On the lagoon itself were little flocks of blue-winged teal. One morning at dawn while watching through powerful binoculars a long-winged man-o'-war bird far out at sea I saw in the distance beyond it a tiny moving speck driving in from the north toward the land. Gradually this object became larger until finally as it reached the beach and rose a little to pass over it I identified it as a swiftly flying blue-winged teal. I realized then that I was actually observing one of our northern birds as it made a landfall on the Venezuelan coast after its long flight across the ocean.

The first of November I moved to a country house in the mountains near Rancho Grande at an elevation of 3,200 feet, a short distance below El Portachuelo where the road crosses the pass to descend to the coastal area on the north. The mountain slopes were grown with

FIG. 23.—The precipitous peaks from which the town of San Juan de los Morros takes its name. November 21, 1937.

FIG. 24.—Farmhouse at Hato Paya, in the northern Llanos. November 12, 1937.

dense rain forest where huge trees rose from buttressed roots to heights of 150 feet or more. Their trunks were wound with climbing figs and other vines, masses of parasitic plants covered their limbs, and from their tops long, slender lianas hung like ropes, sometimes dropping 50 to 75 feet without leaf or branch to break their straight, symmetrical lines. Below there were dense growths of shrubbery, palms with trunks set closely with long, black, needle-shaped spines that reminded me always of spine-covered sea-urchins, and masses of vines and creepers. The vegetation everywhere was saturated with water from the daily afternoon rains.

In this great, uninhabited forest birds were as abundant as in the lowlands, though sometimes they were found with difficulty because of the dense growth. Walking quietly, aided by the wet leaves underfoot, I came across long-legged, stub-tailed ant-birds (*Grallaria haplonota*) that ran alertly on the ground like robins, but that at any noise slipped silently away. Brilliant cotingas (*Euchlornis formosa*) with bright green backs, yellow underparts, and a large spot of deep red in the center of the breast ate the drupes of berry-bearing shrubs in company with a brilliant company of small tanagers whose colors embraced the most vivid hues of the spectrum. Musical-voiced wood wrens (*Henicorhina*) sang from shadowy tangles, while in the bushes above were ant-shrikes, flycatchers, and allied species in almost endless variety. The tree tops were given to warblers, honey-creepers, parrots, small hawks and trogons, while in the sky above were swifts and swallows. Often the report of my gun brought answer from hoarse-voiced howler monkeys ranging wooded ridges a mile away across deep valleys.

In early November with Mr. Ventura Barnés I left Maracay one morning at dawn and traveled southward. We drove slowly until noon, watching for birds, our road traversing a broad, open valley bounded by rolling hills, and crossing many shallow streams. After many years of anticipation I was at last to see something of the Llanos, the great, level plains that extend down to the Río Orinoco. We came out of the hills below Ortiz, to find the land level but grown with dense thorn scrub. The elevation ran from 360 to 400 feet above sea level though we were far in the interior. That night we reached the little settlement of El Sombrero where I remained while Mr. Barnés returned to Maracay.

The town was placed beside the Río Guarico, a swiftly flowing, shallow, muddy stream. Here there were open prairies, some of them more than a mile in extent, on which I found the spur-winged plover (*Belonopterus*), an old friend of previous expeditions farther south.

FIG. 25.—An open savanna near El Sombrero in the Llanos. November 15, 1937.

FIG. 26.—Evening on the Río Guarico at El Sombrero. November 16, 1937.

The thorn scrub extended on every hand like a level sea until, 15 or 20 miles farther south, there opened vast savannas with stony soil grown with low bunch grass across which autos were driven during the dry season in any direction without regard to roads.

In this primitive region with its small human population the general conditions reminded me strongly of the Chaco of northern Argentina, Paraguay, and Bolivia. Here I found birds in great abundance, many of kinds not encountered previously. Large, yellow-headed, yellow-breasted blackbirds (*Gymnomystax mexicanus*) ranged in flocks over the prairies; pigeons, large and small, abounded; and speckled, crested quail rose with roaring wings to dash away through the bushes. One little brown-cheeked parrakeet was known to the native boys as *cara sucia*, or "dirty face." Hawks and falcons were abundant, and it was instructive to note that other birds, both of game and nongame varieties, did not seem to suffer in the least from the large numbers of these predators. Those who have destroyed our hawks in the United States would do well to study such a situation.

After the shade of the dark forests of Rancho Grande the brilliant sun of the Llanos was almost oppressive for the first two days. Though the rainy season was at an end, torrential rains came nearly every afternoon so that the air was constantly humid.

Along the Río Guarico were dense lowland forests where parrots, flycatchers, warblers, and hosts of other birds abounded. One tiny tropical vireo (*Pachysylvia aurantiifrons*) sang clearly *re-seárch, re-seárch, re-seárch*, a scientific reminder that there was much to learn in this fascinating region. Along small channels running back from the river to my surprise I found the uncouth hoatzin, a species that I had not expected so far from the Orinoco. This is a bird related to the fowls, that lives in low trees and bushes over water, flies only when necessary, and feeds on leaves, for which it has developed a large crop with curious muscular walls. When young, the hoatzin with claw-armed wings climbs about in the branches near its nest like some reptile.

The northern Llanos marked my final point for work, and I remained here until the last possible moment. There followed a day in Maracay, devoted to packing the nearly 450 birds that I had secured, and two days in Caracas for official calls and visits. On November 25 I came down again to La Guaira, and sailed for the north on the Grace Line boat *Caracas*. All through the afternoon from the sundeck of the ship I watched the dim outline of the steadily receding coast range with the hope that some day I might return for further studies of Venezuelan birds.

COLLECTING ANIMALS AND PLANTS IN PANAMA, 1937

By GERRIT S. MILLER, JR.
Curator, Division of Mammals, U. S. National Museum

During the dry season of 1937 I visited Panama in order to become acquainted with a typical area in the continental tropics and to collect vertebrates and plants needed to supplement the large series of specimens from this region already in the National Museum. Accompanied by my wife and Charles M. Wheeler, a recent Harvard graduate in biology, I spent three months and three days in and near the Canal Zone, January-April, 1937, as the guest of Colonel Stuart C. Godfrey, in command of the Eleventh Engineers who are charged with the maintenance and defense of the Canal.

Living at Colonel Godfrey's headquarters in Corozal, with its roomy screened porch for a laboratory, and enjoying the cordial cooperation of the military and civil authorities, we found ideal conditions for our work. In the time at our disposal we were able to see the greater part of the Canal Zone, something of the Madden Lake region, where we camped on the Indio River surrounded by magnificent rain forest, and parts of the less humid Pacific slope drainage area from the Rio Jagua and Chepo toward the northeast (toward Colombia) to Venado Beach and El Valle toward the southwest (toward Costa Rica). We also visited the Pearl Island Archipelago and the islands of Taboga and Taboguilla. On the Indio River and Pearl Island trips our camping at each place was made comfortable and agreeable by Mrs. Miller's skillful cooking and her care of our sleeping arrangements.

The general characteristics of this region have already been so fully dealt with in Smithsonian publications, notably in Goldman's report on the mammals (Smithsonian Misc. Coll. vol. 69, no. 6, Apr. 24, 1920) and in Standley's report on the plants (Contr. U. S. Nat. Herbarium, vol. 27, 1928) that it does not seem necessary to redescribe them here. I need merely say that the toucans and woodhewers in the rain forest on the shores of Madden Lake enjoy a yearly rainfall of about 70 inches, while the pipits and meadowlarks on the savannahs 30 miles away to the southeast must be content with only about half as much. With this great difference in water supply, the two regions present striking contrasts in both flora and fauna, contrasts whose appreciation is made easy by automobiles and good roads.

Two visits to Barro Colorado Island, with its clearly marked trails and well equipped laboratory, were especially enjoyable. Dr. Zetek, the able director, and Dr. Chapman, the island's most distinguished guest, easily convinced us that there could be no better place for the

FIG. 27.—Leaving New York.

FIG. 28.—Ships going through the Panama Canal.

FIG. 29.—The farthest point of our journey. A village in the Pearl Islands.

FIG. 30.—A tame spider monkey at the Old Panama zoo.

FIG. 31.—A tame marmoset at Corozal.

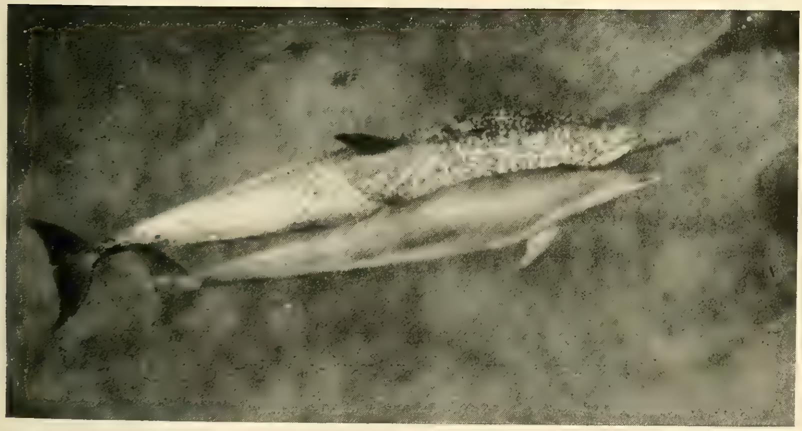


FIG. 32.—Porpoises in the Gulf of Panama.

study of tropical life. But our commission to obtain birds for skeletonizing brought us into conflict with wise restrictions on the use of guns, and made it necessary for us to go elsewhere for such collecting.

Through the cooperation of Dr. Herbert C. Clark, director of the Gorgas Memorial Laboratory in Panama City, and the expert boatmanship and harpoon work of Ernest Stahler of Balboa, C. Z., we obtained eight specimens of one of the several species of porpoise that inhabit the Gulf of Panama. Two individuals, adult and immature, of this animal swimming near the surface of calm water, between Pedro Gonzales Island and Taboga Island, are shown in the very unusual photograph contributed by Otis Barton (fig. 32). The handling and preparing of these bulky specimens were made easy by the facilities of the Gorgas Laboratory and the unfailingly efficient cooperation of Dr. Clark and the members of his staff. It was also to Dr. Clark that we owed the planning of our trip to the Pearl Islands, on the motor boat operated by R. O. Shuey.

In the small but interesting zoological garden conducted by D. D. H. March at Old Panama I had an unusual opportunity to observe the manner in which a tame spider monkey stood and walked in the upright position. This manner of walking for considerable distances, often resorted to by some individuals, but less frequently by others, seems to be peculiar to the spider monkeys among those members of the tribe that occur in Panama. I, at least, have never seen it except in this one kind. When walking erect a spider monkey uses its foot in the same manner as a chimpanzee or a gorilla ; that is to say with the great toe widely separated from the other toes and serving as one of the prongs of a fork when the heel muscles pull the back part of the foot upward during the forward step, or when the foot is resting flat on the ground. The photograph at the right of figure 30 shows how different this is from the action of the human foot with all its toes working nearly parallel with each other.

Again I want to record my appreciation of the many opportunities and facilities for collecting that Colonel Godfrey and Dr. Clark arranged and for the many comforts and conveniences they provided. Mr. Wheeler's untiring enthusiasm and industry combined with his biological interest and knowledge made his volunteer contribution an essential part of the success of the trip.

As the result of our work we brought home about 480 mammals, about 150 each of birds and reptiles, and about 250 plants. In addition there are a few interesting mammals presented by Dr. Zetek, and about 50 mammal skulls and skeletal parts presented by Dr. Clark. On Taboga and Taboguilla we collected numerous samples of the Indian artifacts that are to be found at the aboriginal village sites.

COLLECTING BIRDS AND MAMMALS IN TENNESSEE

By WATSON M. PERRYGO
Scientific Aid, Division of Mammals, U. S. National Museum

In continuation of work begun last year in West Virginia, the collection of birds and mammals was undertaken this year in Tennessee to obtain material lacking in the collections of the National Museum. We had the cooperation of Howell Buntin, Director, Game and Fish, Department of Conservation, Nashville, Tenn., who granted the necessary permits, and also of officials everywhere concerned with game or with the care of National Forests or State Game Preserves.

With Carleton Lingebach as assistant, I left in the early part of April 1937 to begin the work in the Austroriparian life zone in the Mississippi River bottoms in the vicinity of Memphis, where we remained for about 2 weeks collecting in the cypress swamps, obtaining many interesting specimens of birds and mammals. Leaving here, we went to the northwestern part of the State for work around Reelfoot Lake, one of the most interesting spots in Tennessee for nature lovers, nimrods, and anglers, as ducks, fish, and other game abound, as well as wild creatures in general. This lake was formed in the winter of 1811-12 by a series of earthquakes that caused the low land to sink over an area approximately 4 miles wide and 14 miles long. During our successful 2 weeks here we were joined by Dr. Herbert Friedmann, curator of birds of the National Museum.

As the spring season was now farther advanced we moved to a higher area in the densely forested, rolling hills of Wayne County. It is said that the last wolves taken in the State were killed here a number of years ago, and, to judge from the many sites we saw along the creeks, the region evidently was once well populated by Indians.

Continuing north, we stopped during the latter part of May at Crossville on the Cumberland plateau, where we obtained a variety of birds, although mammals were very scarce. On June 1 we moved into the high mountain area of the northeastern part of the State, where we camped in beautiful, fertile Shady Valley which lies between the Holston and Iron Mountains at an altitude of 2,900 feet. Dr. Alexander Wetmore joined us here for a few days. In the glade in the center of the valley we obtained many desirable specimens. Grouse were very abundant on the mountains, and among the many interesting birds collected was a Swainson's warbler taken in a miniature bog on the Holston Mountains.

Through the cooperation of the National Park Service we had permission for work in the Smoky Mountains National Park. On the

Fig. 33.—Falls Creek Falls on the Cumberland Plateau.

Fig. 34.—Looking across Shady Valley, Tennessee, with Iron Mountain in the background. June 7, 1937.

FIG. 35.—Camp in the Cherokee National Forest on Big Frog Mountain.

FIG. 36.—Looking east from Roan Mountain, altitude 6,313 feet.

advice of Mr. Stupka, Park Naturalist, we located near Cosby, where we remained for the latter half of June collecting in the Canadian zone on Mount Guyot, the second highest peak in the Park, at an altitude of 6,600 feet, and on the adjoining knobs.

Mount Guyot proved to be most fruitful for Canadian zone birds and mammals. In the deeply shaded woodlands of this high mountain we heard the beautiful song of the winter wren, and found many nesting warblers and the olive-sided flycatcher. The Cloudland red squirrel was scarce, and we were unsuccessful in an attempt to find the Canadian flying squirrel. Two black bears were seen.

We spent the first half of July in the Cherokee National Forest, camping at the base of Big Frog Mountain near the southern border of the State. From here we collected on Big Frog, Little Frog, and Beans Mountains, obtaining a fair number of specimens. On July 19 we returned to Washington.

I left Washington for the autumn collecting trip on September 9 accompanied by Henry R. Schaefer as assistant. At Bristol we obtained permission from the Forest Ranger to collect on Roan Mountain, which is about 6,300 feet high, located on the North Carolina-Tennessee border. After about 8 miles of climbing in low gear along a rough, winding mountain road we reached the top and pitched our tent on the leeward side. This is said to be one of the coolest spots in summer in the southeastern United States. Each morning ravens passed over our camp flying north, and many other unusual birds and mammals were seen. In spite of the fogs and other adverse weather conditions we added materially to the collection while in this region. We obtained one specimen of the northern flying squirrel at an altitude of 5,500 feet in the birch woods.

At the end of September we moved for about a week to Clinch Mountain, where the forest consists of second and third growth pine and hardwoods, and made a fairly representative collection.

The first week in October we returned to the Mississippi lowlands at Reelfoot Lake to follow the fall migration in the cotton-growing districts and the wooded bottomlands. Considering the windy weather, which handicaps collecting at this season, we obtained good results. Following this, we spent about a week in the tobacco-growing section of Clarksville, making collections along the Cumberland River, which is one of the few rivers flowing north in the United States.

On November 1 we moved to Fayetteville, south of Nashville, collecting in the farming sections of Lincoln and Giles Counties. A fruitful 10 days here completed our work for the season.

THE NATIONAL GEOGRAPHIC SOCIETY—SMITHSONIAN EXPEDITION TO THE EAST INDIES

By W. M. Mann
Director, National Zoological Park

On January 19, 1937, the writer, accompanied by Mrs. Mann and Dr. Maynard Owen Williams, Chief of the Foreign Staff of the National Geographic Magazine, sailed from Vancouver for the Orient, to be joined there later by Messers. Roy Jennier and Malcolm Davis, of the National Zoological Park, and by Layang Gaddi Sang, a zoological collector from Bangkok, Siam. The expedition was financed by the National Geographic Society, and its purpose was to collect living animals, birds, and reptiles to bring back for the National Zoological Park. Jennier and Davis, who sailed later, brought with them a small collection of American animals which were turned over to the zoos in Siantar, Johore, and Batavia.

Early in March the party assembled at Pematang Siantar in Sumatra, which was our base camp for the following five months. Dr. J. A. Coenraad, director of the zoo at Siantar, befriended us and helped us get in touch with native collectors. J. M. Lynkamp, manager of the Naga Hoeta Tea Estate, allowed us to occupy a temporarily abandoned hospital, the Roemah Sakit Pantoean, where we were able to live in comfort and to care for the animals that almost immediately started coming in from the natives.

After spending a month establishing relations with these native collectors, Mrs. Mann, Dr. Williams, and the writer journeyed down the Archipelago as far as Amboina in the Moluccas. Dr. Coenraad accompanied the party and made a hurried trip to Sorong, off the coast of New Guinea, where he remained for 9 days, while the rest of the party stayed at Piroe on the island of Ceram. The Moluccas were rich in gaily colored lories and cockatoos. There were also obtained some Megapodes, common in the wilds but exceedingly rare in captivity, as well as several interesting reptiles, among which was the brilliant and seldom seen amethystine python. The parties met again at Ambon, Dr. Coenraad having made a collection of birds of paradise, crowned pigeons, and other New Guinea desirables. They returned to Sumatra via Macassar, where numerous additional specimens were obtained. In Java the officials of the Zoo at Batavia presented us with a number of rare specimens, including gavials from Borneo and tantillus storks.

Shortly after our return to Siantar, our party was joined by Professor and Mrs. C. T. Brues, of Harvard University, who came to

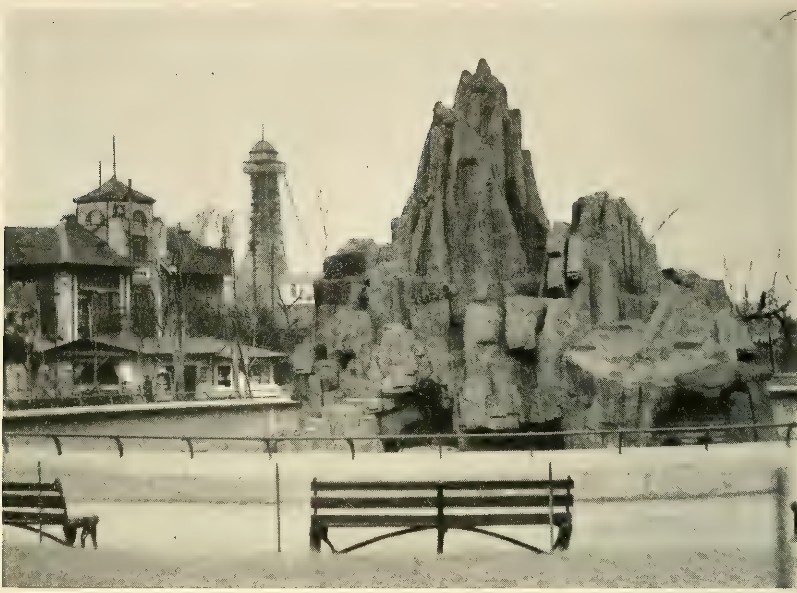


Fig. 37.—A monkey island, peopled with the native monkeys of Japan, a most attractive exhibit.

Fig. 38.—In the Japanese Zoos herds of sea lions are maintained. The commotion at feeding time is terrific.

FIG. 39.—In Ceram our most important catches were cuscus (to the left) and Maleo fowl (to the right).

FIG. 40.—Natives of Ceram danced the Chacalele. After the combat, the winner is seen taking the head of the defeated—all in fun.

study the fauna of thermal springs, as well as to make entomological and botanical collections, and with them we traveled to the West Coast of Sumatra, visiting the excellent zoo at Fort de Kock. Through the interest of C. Grootes, Secretary to the Resident and in charge of the zoo, we obtained a number of good specimens. Later we went north to the Province of Atjeh, with good success.

Toward the end of our stay Miss Barbara Lawrence, of the Museum of Comparative Zoölogy at Harvard, and Congressman B. T. Castellow, of Georgia, visited our camp to collect and hunt in that district.

FIG. 41.—Our bird department in the camp at Siantar. We arrived in Washington with 115 crates of birds.

On July 17, Mrs. Mann and Messrs. Williams and Mann made a hurried trip to Bangkok, to secure gibbons and other Siamese species. The Minister of Agriculture and Fisheries, Phya Jolamark, and Phra Charan, head of the Pasteur Institute, greatly assisted us in obtaining specimens. The latter presented us with a fine collection of venomous snakes, and we soon gathered considerable other material.

On our return to Singapore, Crown Prince Ismail of Johore contributed a beautiful pair of black leopards, and a Bennett's cassowary. In the meantime the Departement Economische Zaken had made an expedition to Komodo, in which we participated—result, a pair of Komodo dragons.

FIG. 42.—Hari grew from almost nothing to a sizeable tiger before we got him to Washington.

FIG. 43.—These anoas (pigmy buffalo) are at police headquarters in Macassar. We obtained two of them and brought them home.

We embarked on the *M. V. Silverash* at Singapore. At Belawan Deli we were joined by Jennier, Davis, and Gaddi, who had brought the collection to the port on a special railroad train furnished through the courtesy of A. Baron Van Styrum, of the Deli Railroad. Layang Gaddi Sang, who had proved himself most efficient in field-work, accompanied us to Washington. The return voyage took 50 days, with stops at Colombo, Bombay, Karachi, Port Sudan, and Port Said. At each port a few specimens were picked up—a pair of gaur at Bombay (these from Mysore) and some leopards; and from Port Sudan two pairs of giraffe, a pair of African buffalo, and two shoebills.

FIG. 44.—The hornbill specialist. He came time after time holding a hornbill under his arm. These had evidently been collected with lime, and in the vicinity of Siantar.

The expedition lasted nearly 9 months, and resulted in a splendid addition to our collection at the Zoological Park. Our best thanks are due to the American Diplomatic and Consular Corps for cooperation and friendship, and to the Departement Economische Zaken, which gave us necessary permits for collecting and exporting our live stock.

In addition to living animals, small collections of mammals, birds, fishes, and invertebrates were made for the United States National Museum. Some of these will be reported on at a later time. A few losses were suffered on the home journey, but in general we had excellent luck. The collection as listed after arrival consisted of 46 species of mammals, 93 of birds, and 34 of reptiles and batrachians.

EXPLORING SIAM

By H. G. DEIGNAN

Division of Birds, U. S. National Museum

In January 1937 a collecting expedition for the National Museum was made to Doi Pha Hom Pok, a mountain over 8,000 feet high lying partly in the Shan State of Mu'ang Hang and partly in the Siamese district of Fang. The name, which means Mountain of the Blanket, refers to the bank of cloud which usually lies on its slopes. It proved to be impossible to ascend the mountain without a guide, and, as no one could be found who knew the trail, camp was made at a small village in the foothills, on the banks of the Me Mao, a brawling mountain torrent. Valuable general collections were made in this neighborhood, which had never previously been investigated. From this place, travel was continued to Chiengsen Kao, a ruined city on the bank of the great Me Khong, by way of an unfrequented path which skirts the northern boundary of Siam. The Chiengsen district is famous for the vast numbers of ducks and other waterfowl occurring there during the cold season, and we succeeded in collecting numerous birds of this type, many of them new either to the Kingdom or to the northern provinces.

February was spent in the southwestern portion of North Siam, collections being made in the hilly country on the Siamese bank of the Salwin. This district was only separated by the river from the Burmese territory of Karenni, and the White Karens (in reference to the color of their garments, in contradistinction to the Red Karens) proved to be the dominant people of the area. The fauna appeared to be typical of the Himalayo-Burmese mountain chain, which continues on to Tenasserim, but none of the peculiar forms of Karenni was found, the great gorge of the Salwin seeming to act as an effective barrier even to the birds.

In March Doi Chiengdao, a great massif of metamorphosed limestone more than 7,000 feet high, was re-visited; its summit has been reached by only six Europeans. Camp was made at 4,500 feet, near the highest spring, at this season all but dry, and a miserable week was spent here, tormented by insects and endangered by forest-fires, which were devastating the stands of pine. The summit of the southwest pinnacle, exactly 7,000 feet above sea-level, was reached; there

FIG. 45.—Doi Chiengdao towers 6,500 feet above the rice-fields. Here it is seen at a distance of 10 miles.

FIG. 46.—Jagged rock walls rise out of the jungle west of the mountain-mass.

FIG. 47.—At the summit of Doi Chiengdao grow many endemic species of plants. The palm (*Chamaerops* sp.) occurs with such northern genera as *Primula* and *Gentiana*.

FIG. 48.—A knoll shaded by Khasya pines and overlooking a cluster of Mussö houses afforded a pleasant camping ground. Titmice fed in the pines with minivets.

was no path, and much of the ascent consisted in scaling hazardous precipices of crumbling rock. In spite of the lack of water and the sun-dried vegetation, fresh signs of a bear were discovered at the top, and the remains of a *Petaurista,* recently killed (perhaps by a leopard) were found. Birds, mollusks, and insects were collected. During the descent, the dry grass below us was set afire, presumably by a wandering party of hill-men, and we managed to return safely to camp only by going down a difficult cliff, which permitted us to reach an area where the fire had burned itself out. Return to the plains was made by a new route, along a ridge parallel to the southern face of the mountain, offering indescribably magnificent views of the precipices, which are among the highest and sheerest in the world. The day was enlivened by the sight of bear, sambhur, goral, and serow, as well as great flocks of *Cerasophila thompsoni,* one of the rarest of Oriental birds.

April was spent in the southern portions of Nan province, the center and north of which had been visited during 1936. The route lay wholly in the lowlands, and, with the increasing drought, travel became almost intolerably difficult; all minor streams were quite dry and water-holes were as much as 40 kilometers apart. The forest, largely hot-weather deciduous, was by now leafless, offering no respite from the sun during the hottest month of the year. It was with relief that we finally reached the river Nan at Pak Li. From this point it was determined to carry on by boat as far as Utaradit and the railway, making camp at nightfall on the sandbars. Game was plentiful on the banks, including peafowl, deer, and swine, and parties of otters were often seen at play in the shallows.

At the end of April, work in North Siam was terminated, and a change was made to the extreme southeast of Siam, the provinces of Chantabun and Trat (Krat). A fortnight was spent at Khao Sa-bap, a somewhat isolated mountain, where a number of remarkable birds have been discovered in recent years. Here, in the most humid part of Siam, where rain falls throughout the year, we found a great contrast to the arid districts of Nan, and field-work was decidedly handicapped by the weather. Later a removal was made to the sea-coast near Chantabun, where the salt-marshes, at low tide, offered a great variety of waders and other water-birds, including the very rare Asiatic finfoot and the Malayan ring-plover, a bird not hitherto known from any locality outside the Malaysian subregion. The final week of work in Siam was spent on the large island of Ko Chang, where numerous interesting invertebrates were collected.

WITH THE MOOSE AND CARIBOU IN ALASKA

By WILLIAM N. BEACH
New York City

Several times during the past few years Dr. Wetmore had spoken to me about getting a new moose group and specimens of stone caribou for the Smithsonian Institution. As I wished to get the finest possible specimens of the Alaskan moose, I felt that it would be necessary to arrange an expedition to go down the north side of the Alaskan Range beyond Mount McKinley, a region known as the Rainy Pass section of the Range. From several trips I had made to this country I was under the impression that the moose there were larger and finer specimens than in any other part of Alaska, even including the Kenai Peninsula.

From the experience gained on four previous expeditions to this country I realized that a successful trip would require careful planning. After several conferences with Dr. Wetmore it was decided that the expedition should be made in the fall of 1937, and a friend, J. Watson Webb, agreed to join me. Harry Boyden, a former guide, was to accompany the expedition, and Mrs. Webb and her two sons, Watson Webb, Jr., and Harry Webb, were to start about 3 weeks ahead of us and proceed to the Rainy Pass country. Their trip was to be largely photographic and exploring. In order to handle these two expeditions we decided it would be necessary to have 30 horses for saddle and pack purposes. The general list of equipment and supplies was made up, and guides were obtained. This particular section of Alaska was chosen on account of the huge quantities of game that I had seen there on my previous trips. It is most inaccessible and difficult to reach and can only be entered by an outfit of one's own.

Boyden left for Alaska in June with the horses, and went directly through to McKinley Park Station on the Alaska Railroad, and from there through the Park over the road to Wonder Lake, which is the terminal of the Park Highway. Mrs. Webb and her two sons arrived at Wonder Lake via plane from Anchorage about 3 weeks ahead of Mr. Webb and myself, and departed down the Range at once. This party had Carl Anderson as head guide.

Watson Webb and I arrived at McKinley Park Station, over the Alaska Railroad, on the evening of August 13, specially conducted by

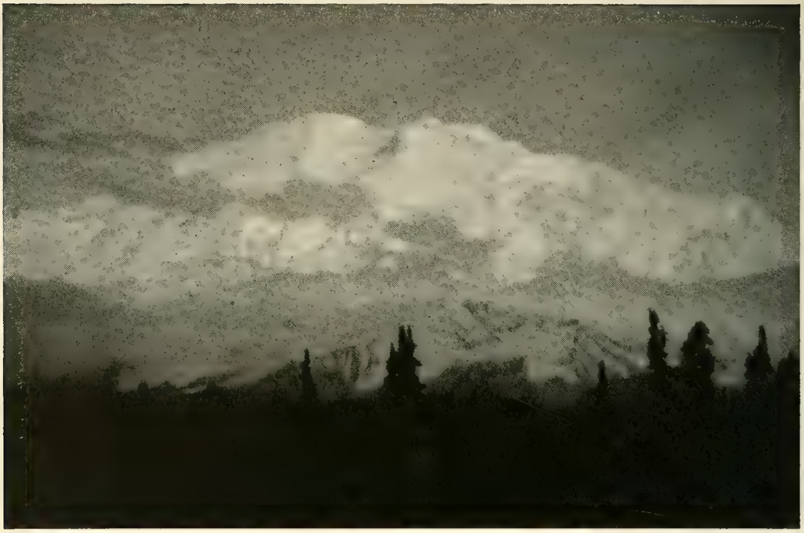


Fig. 49.—Mount McKinley from the head of the Muddy. (Photograph by J. Watson Webb.)

Fig. 50.—At one of the camps.

FIG. 51.—The Alaska Range along the Tonzona.

FIG. 52.—Crossing one of the many rivers. (Photograph by J. Watson Webb.)

Colonel Ohlson on his speeder. We had with us W. L. Brown, Smithsonian taxidermist, who was to take care of the various specimens obtained by the expedition, and Jack Lean, an Alaskan guide, who had been on several former expeditions with me. That night we stopped at the Savage River camp of the McKinley National Park Transportation Company. The next morning we registered at the Park Superintendant's office and received permits for transportation of the various specimens through the Park on our return. We then drove to the end of the motor road and finally contacted Harry Boyden and the outfit, camped on the bar of the McKinley River about 2 miles east of Shannon's Cache.

The lack of game going through the Park was most marked. In 1922 and 1925, when I had been there before, sheep were seen on all sides, great bands grazing at the head of Savage, Sanctuary, Teklanika, and Igloo, and in Sable Pass and Polychrome Pass they could be seen in untold numbers. In 1922 I actually counted over 500 sheep in one band on the north side of Polychrome Pass, and on the same day 122 in a band on Sable Pass. At the head of the Toklat, a ram pasture, there were bunches of rams everywhere. This condition existed to a greater or less extent the entire length of the Range to Rainy Pass. On our trip through the Park this year we saw 19 sheep.

That afternoon we busied ourselves getting packs balanced and putting the finishing touches on the outfit. August 15 was a day of hustle, with the many contributing delays that one encounters on the first day in getting an outfit under way. We finally were on our way at 11:40 a. m., and traveling across the McKinley River, made directly up to the high gravel ridge that lies along the greater part of the McKinley Range. We were bothered with shifting packs most of the day, but beyond this we had no unpleasant experiences and made our first camp at the head of Muddy River at 5:40 p. m. at the exact spot where I had camped in 1922. Watson Webb, who had heard me many times rave about this great game preserve, was inclined, I am afraid, to question my veracity, and I was beginning to wonder if it had all been a dream on those previous trips. The evidences of many kills of caribou by the wolves along our line of travel was sufficient to explain the great falling off in the caribou and sheep population.

From the Muddy we made the head of Birch the next day, and then for 3 days we were held there by severe rain. Our next camp was between the first and middle forks of the Foraker River, and here again we were delayed for 2 days by hard rain. We next camped in the Cottonwoods on a branch of the Herron River. On August 24 we crossed the western boundary of McKinley National Park, and com-

FIG. 53.—Mount Foraker in the clouds.

FIG. 54.—The bull for the moose group.

ing down a gradual slope dropped onto the bar of the Chedotlothna River. The rain and warm weather had caused the glaciers to work overtime, so our river crossings gave us more or less trouble. We camped on the west bank of the Chedotlothna some 3 miles down stream.

As we were making camp Jack Lean located two fine large bull moose, and the next morning we secured both of them. The larger one had a fine heavy set of horns, with a spread of 65 inches, and it is to be the center of the new group. The other was also a heavy, well-balanced head of 62-inch spread, and is to go to the Alaska Museum in Juneau. Mr. Brown was left with one of the men to complete the preparation of the animals after the entire outfit had helped on the preliminary work for a day and a half.

The balance of the party proceeded to the Tonzona River. The horse wrangler returned the second day after our arrival at the Tonzona and brought Brown and Charlie back to our camp. We remained on the Tonzona for the balance of the trip, and from there we got five caribou and sheep, and a cow moose for the Smithsonian. We still lacked a calf and a small bull. Every day we would see large bulls and cows, but the cows had no calves with them. The cow we secured had recently had a calf, as her udder was full of milk, but the wolves had undoubtedly done away with it.

The specimens were all packed to Tonzona Lake, where we had built a cache. Mr. Brown and Jack Lean were left with the specimens, and on September 14 they were flown out to Anchorage with a load of specimens, the rest of the collection going out the next day. But for the plane, I doubt if we would have been able to get all the specimens out before snow, and then we would have had to send in dog teams to haul them.

It became apparent that we would not be able to get the calf and small bull moose to complete the group in the Rainy Pass section. We therefore arranged with Jack Lean to go to the Kenai and obtain these specimens there. Specimens of plants and bushes were taken by Mr. Brown to be used in the moose group.

GREENLAND EXPEDITION OF 1937

By CAPT. ROBERT A. BARTLETT

New York City

In continuation of investigations that I have been carrying on for several years in the Arctic regions for the Smithsonian and other institutions, I visited the west coast of Greenland during the past summer. One of the main objectives of our trip was to get walrus pups for the Chicago Zoological Society. As part of our collecting outfit, we took along what was for us a brand new type of gear—an otter trawl, suggested by Dr. Waldo L. Schmitt, of the U. S. National Museum, and bought for us by Bassett Jones, of Nantucket and New York. The use of this apparatus opened up a whole new vista of Arctic marine life to our astonished eyes.

Our crew was pretty much the same as last year, with Brother Will Bartlett going again as mate. The lads that went along and helped me finance the trip were Buck Morris, Plymouth Meeting, Pa.; Francis C. Grant, Chestnut Hill, Pa.; Warner Kent, Scarsdale, N. Y.; and David C. Nutt, Cleveland, Ohio, all of whom had been with me the previous year, besides David Munsell, Garrison, Md.; Bob Graff and Stuart Miller, Scarsdale, N. Y.; Howard McCall, Wynnewood, Pa.; Bob Wurtz, Short Hills, N. J.; Gerry Redmond, Locust Valley, Long Island; and Bross Lloyd, Lee, Mass. The boys all stood regular sea watches, helped to handle the schooner, and tackled any job that they were called upon to do without complaint. They were at all times attentive and efficient. One could not wish for a better crew.

Clifton Foss was the radio operator on board, while back in Brooklyn his young and capable wife kept the home fires burning, all messages being relayed through her. She is as good an operator as her husband and kept our relatives and friends well informed of our doings.

Dr. Schmitt saw to it that we were sent a proper outfit from the National Museum: chests of bottles, a bottom sampler, tow nets, and sundry necessary equipment. Our surgeon, Dr. Richard Knight, of the Presbyterian Hospital, New York, was in general charge of the collecting of specimens of all kinds. David Nutt, Warner Kent, Bross Lloyd, and Stuart Miller assisted him from time to time.

After leaving City Island, New York, on June 22, we stopped in Nantucket, where Bassett Jones came aboard the *Morrissey* for a

Fig. 55.—The *Morrissey* and an iceberg, Melville Bay, Greenland.

Fig. 56.—Another large berg, Melville Bay, northwest Greenland.

Fig. 57.—Boys getting young Hood seal. One of the lads had shot it.

Fig. 58.—Dr. Knight giving a lesson in marine biology to Bob Wurtz, Dave Munsell, and Gerry Redmond.

day to instruct us in the use of the trawl. On the fishing grounds outside Nantucket we lowered it twice and fished for an hour. The first time we hauled we did not have much, but the next time we had several barrels of fish, all edible. This experience gave us just the line we wanted on the new gear, as we did not want to leave without knowing how to handle it up north. We hoped to get fish in the far north, and although we did not get many, we made a grand showing with all the other forms of marine life.

From Nantucket we headed for Brigus, and from there proceeded up the coast to Labrador, where there are many fine harbors. In one of them we put over a hard northeast gale and a very heavy sea.

Our first port of call in Greenland was Godhavn, to report my presence in those waters to Governor Rosendahl, and also to land Dr. Erling Porsild, botanist, of Ottawa, Canada. His parents, Dr. and Mrs. Morton Porsild, reside at Godhavn, where his father is in charge of the Biological Station. I stayed about two hours, long enough to fill the tanks with fresh water. Captain Eigil Riis Carstensen, R. D. N., Hydrographer and Commander of the new Danish Coast Survey steamer *Hajmdal,* Dr. Morton Porsild, Chief Radio Operator Miller of the radio station at Godhavn, and Pastor Rosen came on board. We had a grand visit from Governor Rosendahl, as well.

We went on to the Peary Monument at Cape York and were extremely fortunate in finding Melville Bay free of ice. At first I intended to stop at Ootah's village, about 6 miles east of the monument, but it was fortunate for four Eskimos of the Cape York village that I changed my mind. As we neared the Cape, a nasty squall of wind struck us. At that moment I saw the four natives on a piece of ice with four kayaks and a dead walrus. The sea was breaking over the ice and wetting them. It would soon have gone to pieces. We got them just in the nick of time, yet some people say there is no such thing as luck.

We went around and anchored in the cove on the north side of the Cape. The glacier had changed a lot since we built the monument. The fall of the glacier would make the hauling up of supplies much more difficult now. The wind blew a gale on the top of the mountain, and a dense white fog made it impossible to take pictures. Most of the lads climbed to the top of the monument. David Nutt and Bob, the second engineer, obtained specimens of red snow, as well as algae and other forms of life in the lakes, pools, and rivers near by.

Farther on, at Northumberland and Hakluyt Island, we stopped for birds, flowers, and other shore collecting. From Hakluyt Island to

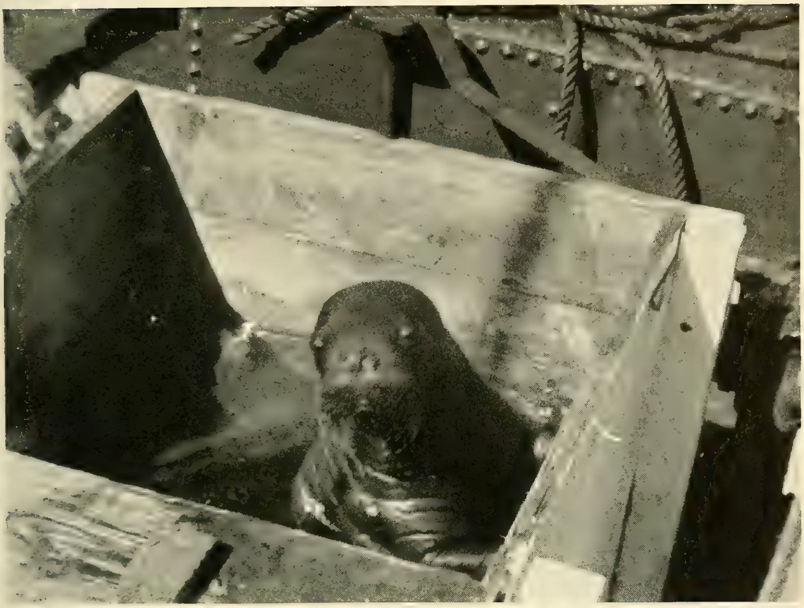


FIG. 59.—There are two walrus pups in the tank. One is hiding. They were very happy.

FIG. 60.—Bob Graff and Howard McCall talking to the Eskimo girls of Cape York, Greenland.

Cape Alexander we tried using the trawl, but found the water too deep for the rope we had. We therefore went closer inshore between Cape Chalon and Cape Alexander. Ice prevented us from using the trawl in Kane Basin, as I had hoped, but we did use it in Smith Sound, where we also got in some hauls with the iron dredge and plankton net.

The farther north we went, the finer the weather became. We reached latitude 78° 45′ at a point in Smith Sound midway between Cape Sabine, Ellesmere Land, and Greenland. We saw numerous schools of narwhal swimming in the open water close to the edge of the very heavy Arctic ice. It was here that we got the two walrus pups which we had come so far to seek. A few birds were taken on McGarry-Littleton Island and around Pandora Harbor.

The ice lay close to the Canadian shore, almost to the Cary Islands, and thence to the mouth of Jones Sound. We had a delightful trip almost to the bottom of Olrick's Bay. As we sailed out of Olrick's Bay at 2 a. m., the sun on the opposite shore skimmed the tops of the mountains and ice caps, producing most strange and beautiful color effects of russets and browns. Here and there patches of yellow moss looked for all the world like bunches of peaches on trees at home. On the silver surface of the fiord we could see mirrored ice-capped mountains, hills, glaciers, streams, valleys, and plains. Several bergs floating in the fiord sparkled and shimmered in the light of the sun to the north as it dipped behind the mountains opposite. I shall never forget that night as we steamed out of the fiord right against its eastern gate where the great sun lay robed in vivid flames and amber light.

On our return to Godhavn, I was delighted to learn that His Excellency, Daugaard Jensen, Administrator of all Greenland, would arrive in a few hours on the *Disco*. The next morning I went on board right after breakfast and we had a pleasant visit.

The *Disco* left after the dinner, and so did we. We had a quick and smooth run to Labrador and thence to Brigus, where we stayed a day. Another quick and smooth run brought us to New York, where our two walrus pups were handed over in good shape to Bob Bean, Assistant Director of the Chicago Zoological Society of Brookfield, Illinois. I also gave him the polar bear cub which we captured in Davis Straits midway between Greenland and Baffin Land.

Saturday, September 18, saw the *Morrissey* laid up at her old berth, McWilliams Shipyard, West Brighton, Staten Island, thus bringing to an end one of the best trips I ever had in her.

THE SMITHSONIAN-HARTFORD EXPEDITION TO THE WEST INDIES, 1937

By WALDO L. SCHMITT

Curator, Division of Marine Invertebrates, U. S. National Museum

Not since the early days of the Museum has one of its expeditions gone to sea in an old-fashioned full-rigged ship, the kind you read about in sea-tales laid in the days of wooden ships and iron men. Just such a ship was the *Joseph Conrad,* which George Huntington Hartford III, of New York, recently acquired and refitted for a voyage of exploration and scientific investigation to the West Indies under the auspices of the Smithsonian Institution. One can well imagine with what feelings of anticipation I looked forward to this expedition. The realization did not fall short of them. Our interesting experiences and the good friends who helped us were so numerous that I hope I shall be forgiven for mentioning only a very few of them.

The expedition covered more than 4,500 miles at sea and stopped one or more times for the purpose of collecting at 15 different islands: Bahamas, Andros, and San Salvador or Watling Island; West Indies, Tortuga, Haiti, Puerto Rico, St. Thomas, St. John, St. Croix, Saba, St. Eustatia, Dominica, Martinique, Barbados, Jamaica, and Cuba.

The largest animals we collected were porpoises, the smallest protozoa, chiefly the tiny calcareous shelled kinds known as foraminifera.

Porpoises are among the rarest things in museums. We wanted as many different kinds as we could get, but we saw them more often than we were able to catch them. We were fortunate, however, in the harbor of San Juan, where, from the ship's launch, with "Jack" Hawkins as harpooner, we got our first porpoise, a *Tursiops truncata,* not uncommon along our eastern seaboard, yet taken here as a first record for Puerto Rican waters.

Our second porpoise, taken some 50 miles off the coast of Georgia, was a gravid female of *Prodelphinus plagiodon,* of which the National Museum possesses only one other specimen taken more than half a century ago. The embryo she carried was one of the few ever to come to the Institution, a beautiful mouse-colored specimen not quite 3 feet long, with whiskers on its "lip."

Foraminifera are more easily taken than porpoises. A grab of bottom mud or sand may yield thousands. In between these extremes

FIG. 61.—Fair wind, fair weather. The *Joseph Conrad* under full sail, May, 1937.

FIG. 62.—The ship's company. Eight are missing from the picture. Seated on the extreme right next to Captain Troonin is DuBose Heyward; directly behind him is Bob Lunz, to whose right stands Mr. Hartford, owner, and sponsor of the expedition.

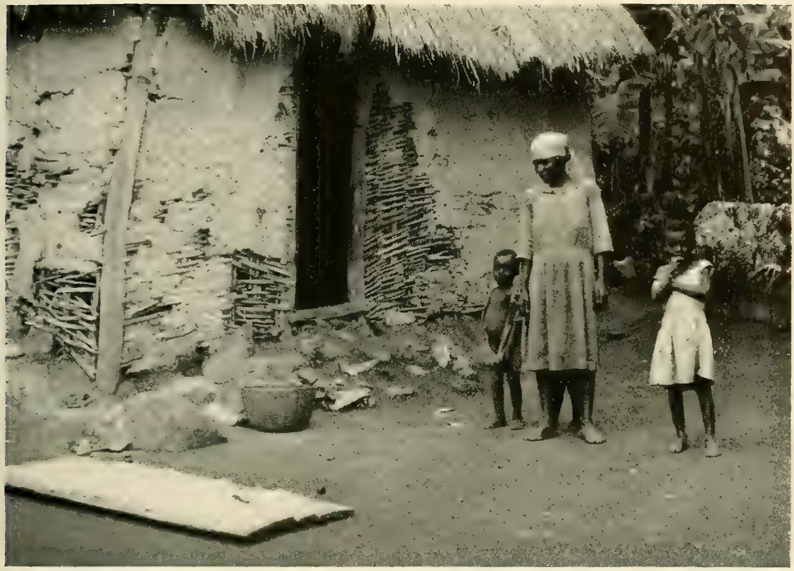


FIG. 63.—Native Haitian homestead, on the road to Christophe's Citadel; mother with her three children. Puzzle: find the third child.

FIG. 64.—At Picheline, Grand Bay, Dominica, the auto in which we crossed the island ran out of gas. Naturally a crowd collected, and here are some of the more youthful of the bystanders.

of size we got a host of other things—shrimps, crabs, and lobsters, corals, shells, and sponges, worms, fish, and algae. Several "brittle" starfish have already been recognized as new species from among those that we brought back, as well as a single specimen of a rare and probably unique form of amphipod, and an unusual crab that "talks" or stridulates. From time to time we shall be reporting on other portions of our biological treasure trove.

On the morning of March 21 we raised the dim outline of the Isle of Tortuga on the eastern horizon. It was here, in the month of December, 1670, that Henry Morgan assembled several thousand freebooters and thirty-odd sail, and set out to accomplish the sack of old Panama, of which there now remain only a few scattered ruins. We stopped for a day's collecting on the sheltering reefs of the Tierra Baja Road, where that famous, or rather infamous fleet was assembled.

Collecting one day on the immense barrier reef nearly 2 miles long which makes the harbor of Christiansted, St. Croix, a safe anchorage, I witnessed a curious sight. A lot of big dark green parrot fish were browsing on algae on the flat of the reef at low tide, their backs half out of water, like so many rooting pigs. When I suddenly came upon them, just like a startled drove of pigs they scuttled away to the deep water seaward, splashing, leaping, and, I almost want to say, squealing, so great was the general commotion until the last one was out of sight over the edge of the reef.

Equally interesting was a hunt for the spiny lobster, *langosta,* at night by torchlight. I was initiated into this sport in Puerto Rico by Lt. J. M. Cabanillas, U. S. N., in charge of the Naval Radio Station at San Juan. He uses an electric light strapped to his forehead with a brace of batteries high up on his shoulders. As he catches these lobsters or crayfish by hand, he wears stout gloves as a protection against the fearsome spiny armature of these sizable crustaceans. We had the good fortune to obtain several specimens of *Panulirus guttatus,* reported in the West Indies from Cuba, Guadaloupe, and Martinique but, so far as I am aware, never before from Puerto Rico.

Haiti, where we visited Christophe's famous citadel, La Ferrière, and Martinique are intriguing places. In both islands the current language is a French patois peculiar to their black inhabitants. In Martinique we went over from Fort de France, where the *Conrad* anchored, to see Mount Pelée, the volcano that in 1902 destroyed more lives than any other since Vesuvius at Pompeii. At the foot of the mountain along the seashore to the southwest lies what was left of the old St. Pierre. It is slowly rebuilding since the disaster of 35 years

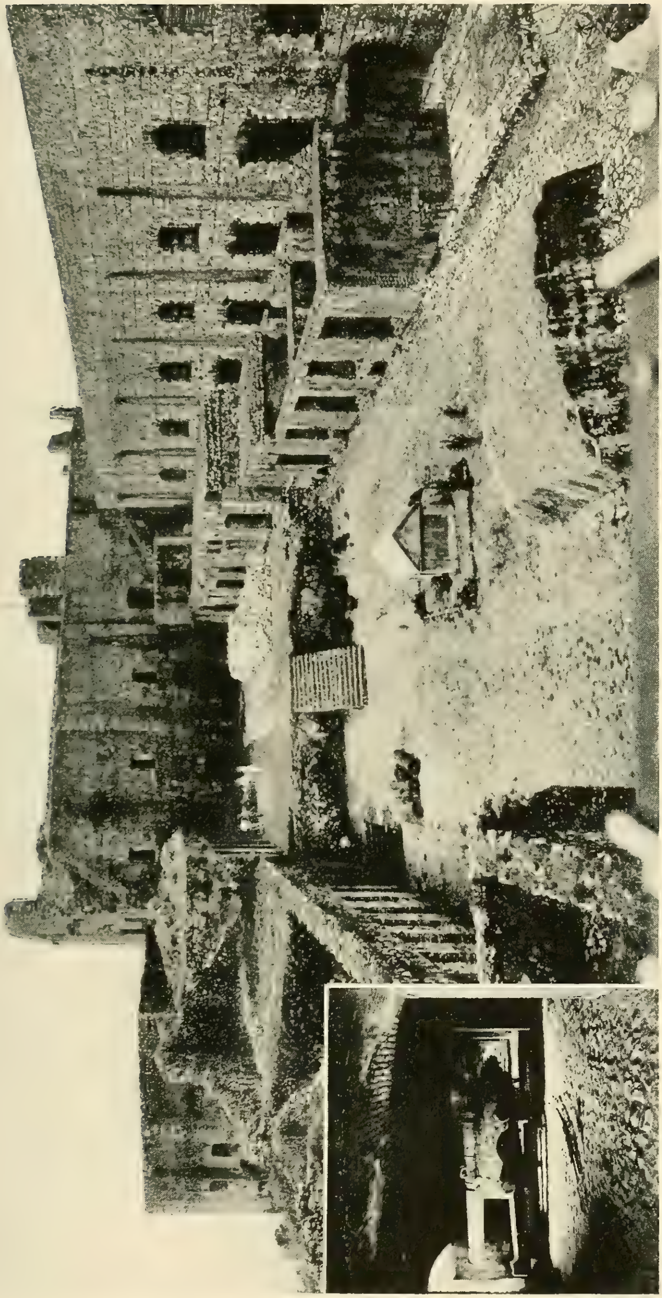


FIG. 65.—The great court at La Ferrière, the Citadel of Christophe, Emperor of Haiti. Built around the very peak of the 3,000-foot-high Bonnet à l'Évêque (the Bishop's Hat), the Citadel dominates the country for miles around. There is no higher mountain within a radius of 10 miles. On a clear day the Citadel is visible from the seacoast 20 miles away.

Insert: First gun of a battery stretching down a gallery 270 feet long on the eastern side of the fortress; just a few of the hundreds of cannon with which the citadel was armed. Its construction occupied the better part of 16 years between 1804 and 1820.

ago and is now a city of about 10,000. Here we renewed our acquaintance with Dr. Frank A. Perret, Director of the Martinique Volcano Museum, whom we had met in Fort de France.

It was a coincidence that the first person to greet me on my return to the Museum after the conclusion of this expedition was J. V. McKeon, of the Museum's mechanical force, who was in St. Pierre the very day after Pelée had broken loose and wiped out the city and its 28,000 inhabitants almost without warning in the space of a very few minutes. A photograph of the city of St. Pierre taken the day after the holocaust and here reproduced was kindly lent to me by Mr. McKeon.

I have to thank Commander R. M. Wynne, R. N., the harbormaster at Bridgetown, Barbados, for a very unusual and interesting experience. Barbados is capped, for the greater part, by a coral rock formation and in part by a deposit of radiolarian, or infusorial earth deposit, indicative of an ancient and profound submergence beneath the sea. Down at the base of this limestone cap are underground water courses from which are pumped up the greater part of the water supply of the island. One of the largest of the wells tapping this supply is at the Bowmanston pumping station. At the bottom of it the superintendent of the station had been kind enough to place one of my baited copper " roach " traps, in the hope that we might discover some subterranean crustacea. Some hours later we ourselves descended to recover the trap from the stream at the bottom of this deep hole, 260 feet below the surface.

We were let down in a bucket on a steel cable, I sitting on the bucket rim with my feet inside. To get to the trap at the bottom, we had to wade chest deep in water. Retrieving it and following the water course in the opposite direction, we passed through a tunnel so low and full of water that our noses were all but submerged. On the other side of this arch or tunnel was an underground river coursing through a cleft or narrow, irregular-walled canyon in the rock that in places may have been 50 to 75 feet high. The stream, where we stood in it, was 4 to 6 feet wide. I thought that this was about all there was to see, but soon learned otherwise. Using a crazy old craft that one of our guides pulled up from the bottom of the " river " and bailed out, we went on for three or four hundred yards in stygian darkness which was only intensified by the flickering torch I held until we came to a waterfall fenced by a man-made wall, through a gap in the top of which, 2½ to 3 feet wide, a foot-thick stream of water poured over in a noisy cascade. It dropped down 15 or 20 feet ; that is why we had to

Fig. 66.—St. Pierre, Martinique, as it appeared on May 9, 1902, the day after the disastrous eruption of Mt. Pelée, in which more than 25,000 people lost their lives in a space of less than 3 minutes. (Photograph courtesy of J. V. McKeon.)

Fig. 67.—Pelée in May, 1937, from the ruins of the old prison of St. Pierre. In a little round thick-walled stone dungeon, similar to the one of which the door is visible in the near right foreground, a condemned criminal survived the deadly blast from the volcano that destroyed every other living thing in that ill-fated city 35 years ago.

have the boat, as it must have been nearly that deep under us. We got out on the wall for a few moments, for this was the end of our journey in this craft, although one can go on for miles under the island, I was told.

Returning to the surface was more of an ordeal than going down, because it was my turn to stand on the edge of the bucket and lay hold of the cable. After we had taken our places, one of the guides blew a whistle, the signal to haul away, but nothing happened. We waited a while a little uneasily, and he blew again. This happened still another time before the cable finally tautened and we were on our way up. My rubber-soled shoes were wet and I thought perhaps too slippery for me to be standing on the thin, curved rim of a metal bucket, but slowly and inexorably we were being lifted up higher and higher. I rather hated to look up at the tiny spot of light that marked the hole through which we had to disappear to regain our freedom. I do not care to describe my feelings. Although in reverse, they were very much like the feeling you might get standing out on the edge of a frail scaffolding at the top of the highest skyscraper you could imagine. It was a relief to let go of that trembling cable and step off that slick bucket edge, so much so, in fact, that I forgot the object of my visit to the nether regions and had to be reminded of it. Except for the bait placed in it that morning, the roach trap was empty!

My assistant naturalist for the trip was G. Robert Lunz, of the Charleston Museum, while our ever-willing helpers in all phases of our work were the whole crew of the *Joseph Conrad,* from Captain Troonin down to the mess boy. A most pleasant shipmate, valued friend and counsellor throughout was DuBose Heyward, of "Porgy and Bess." Above all, however, my personal thanks and appreciation and those of the Smithsonian Institution go to Mr. Hartford, who made possible this scientifically most profitable expedition that has enriched the natural history collections of the United States National Museum many fold.

SMITHSONIAN-ROEBLING EXPEDITION TO CUBA

By PAUL BARTSCH

Curator, Division of Mollusks, U. S. National Museum

In November 1936 Donald Roebling offered to the Smithsonian Institution the use of his newly built yacht, the *Iorano,* for exploration in West Indian waters. The matter was turned over to the writer, who, after visiting Mr. Roebling in December, reported favorably on the project. The *Iorano,* with a length of 70 feet, a beam of 14 feet, a draft of 3 feet 9 inches, and a displacement of 29 tons, made an ideal vessel for shallow marine collecting. Mr. Roebling had made the necessary installation of a small winch and hoisting gear and pump for such work, as well as dredging frames.

The expedition put to sea on April 1, 1937, from the home port of the *Iorano,* Clearwater, Fla. After a stop at Key West and Havana, we cruised along the north coast of Cuba where our first collecting was done on April 5 in Bahia Honda Harbor. Here, by means of outboard-motor-propelled skiffs, we explored the shallow waters of the region for marine organisms, as well as the immediate shores for land mollusks. After dark we used a submarine light, which attracted considerable life to it and enabled us to make a catch of many marine organisms, ranging from protozoa to fish.

On April 6 we anchored off Buena Vista Light and here again we used the submarine light with considerable success. The next day we rounded the western end of Cuba and came to anchor in Bahia Corrientes. In this half-moon-shaped bay the water shelves abruptly to considerable depth, and a strong current sweeps the region. We stopped at several stations in this bay, where we worked until the morning of April 10. A number of dredge hauls were made at various depths, in part on rather difficult bottom, which yielded a good series of specimens.

The most interesting phase of our work in this region, however, came from the use of the submarine light after dark. This apparatus, when used where life is abundant, always yields ample, exciting, and fascinating results. The submarine light consists merely of a water-tight glass jacket surrounding an incandescent bulb in a water-tight socket attached to a water-tight submarine electric cord. Lowering this to the bottom and moving it about a bit will attract myriads of creatures to it. Slowly raising the light to the surface one finds a cloud of microscopic plankton organisms, lending a milky aspect to

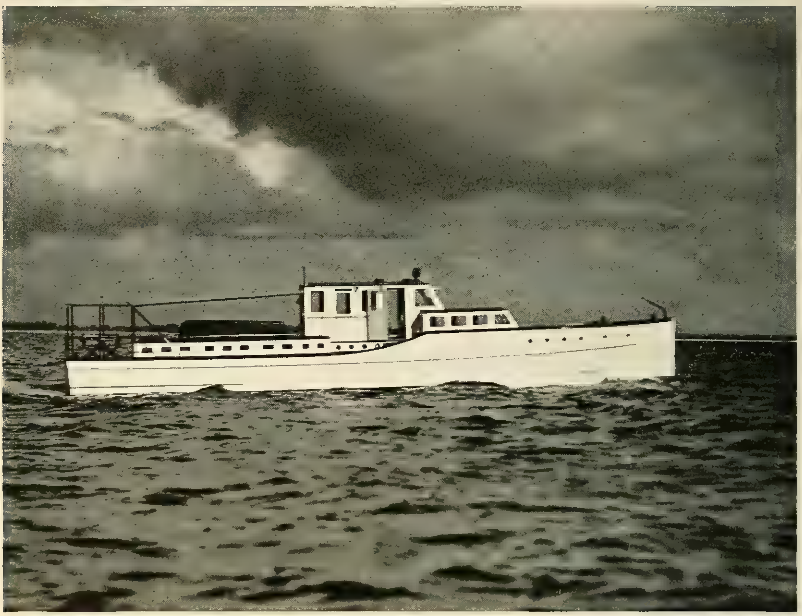


Fig. 68.—The *Iorano.*

Fig. 69.—Sifting the dredgings.

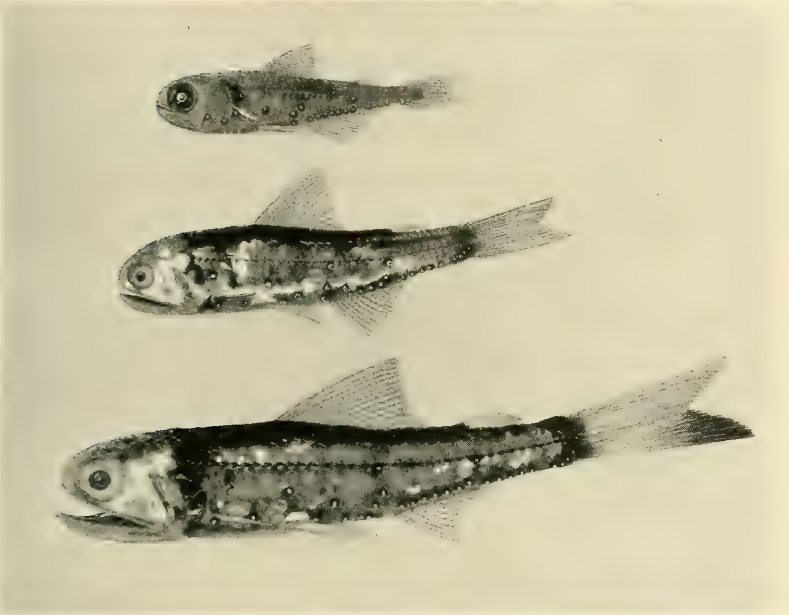


FIG. 70.—Lantern Fish: Top figure, *Myctophum affine;* middle figure, *Diaphus garmani;* lower figure, *Diaphus dumerili.*

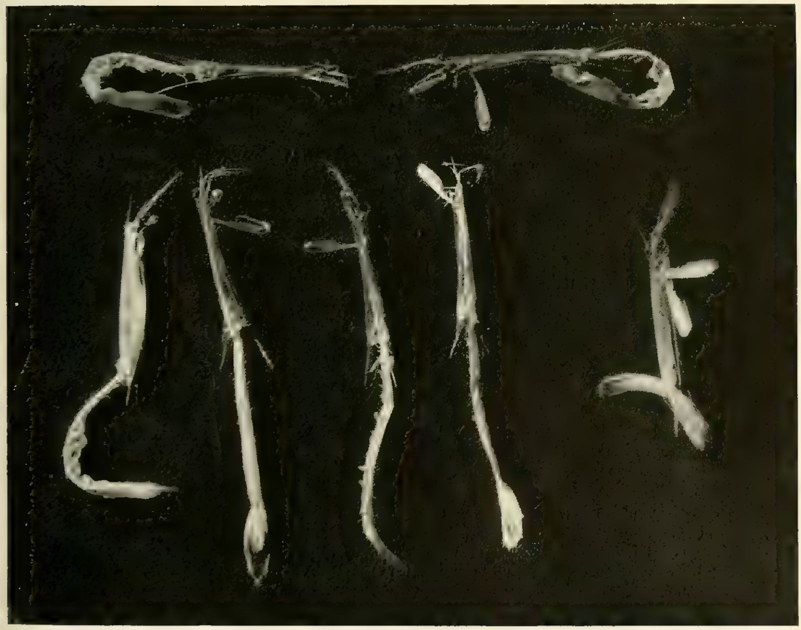


FIG. 71.—Stomatopod larva.

the water immediately surrounding the glass, while through and beyond this fine life, larger organisms pursue their diverse prey. The whole as a rule assumes a spinning motion, a veritable wheel of life.

Here we captured lantern fish, forms usually found at a depth beyond the penetration of light. Lifting the first of these to the surface with a dip net produced exclamations of surprise, for the fish flashed its lamps of blue-green quality like the sparkling of a firefly, the flashes being emitted from the many bioluminescent organs with which they are provided. These lantern fish in turn were pursued by larger fish which occasionally " beat us to it." Of these lantern fish three species belonging to two genera were obtained in quantity, namely, *Diaphus garmani,* 119 specimens, *Diaphus dumerili,* 51 specimens, and *Myctophum affine,* 3 specimens. Among other interesting fish, we caught a large number of *Leptocephali,* larval eels.

We also filled a gallon jar with the larva of a stomatopod crustacean, a flat glasslike creature of curious fantastic shape. These were so abundant that each swish of the net would bring a mass on board and their glasslike skeletons were scattered all over the ship. Then, too, there appeared swarms of a small medusa having a squarish outline with four long streaming tentacles. They probably belong to the genus *Carybdea.*

Leaving Bahia Corrientes we turned to the south coast of the island where we examined the Cayos San Felipe and Cayos de los Indios, as well as the shallow flat surrounding them. This is the famous sponging ground of Cuba. Here we made a number of dredge hauls with varying results and then headed on April 11 for Siguanea Bay at the western end of the Isle of Pines. In this bay we again plied our dredge, and we also paid a visit to the Sierra Canadas, which I had failed to explore on a former occasion.

We next rounded the northern coast of the Isle of Pines and came to anchor April 12 at its capital, Nueva Gerona, where we remained until April 15, visiting the parts of the Sierra Casas and the south side of the Sierra Caballos not previously explored. We then left for Batabano, making a number of hauls in the shallow water between these places and obtaining a marvelous lot of material.

After making our first shipment from this port we sailed eastward, but serious engine trouble caused us to forego further dredging and head for the Naval Station at Guantanamo Bay to undergo repairs. In Guantanamo Bay, tide-pool poisoning was engaged in at Windmill Beach, which yielded a series of interesting and brilliantly colored fish, among them an *Antennarius,* probably *princeps.* At this port it was deemed advisable to terminate the work for the present.

HEREDITY EXPERIMENTS IN VIRGINIA AND WEST VIRGINIA

By PAUL BARTSCH
Curator, Division of Mollusks, U. S. National Museum

In 1912 I began a series of breeding experiments under the joint auspices of the Smithsonian and Carnegie Institutions. I selected for my subjects land mollusks of the genus *Cerion,* which I transplanted to the Florida keys from the Bahamas and the West Indies. These experiments have given very interesting results. They show that environment, as far as Cerions are concerned, produces no appreciable changes in the offspring if the animals are able to exist under the changed conditions. In instances in which the changed environment was adverse, it produced a lethal effect and the colony in question passed out. Hybridization, on the other hand, produced de Vriesan mutations, and these mutations, through segregation, appear to produce fixation, which we hope will eventually result in speciation, the establishment of new species.

To have a check on the Cerion breeding experiments in order to determine whether the results obtained thereby are of broader biological application or merely phenomena peculiar to the genus *Cerion,* I have selected *Goniobasis virginica,* a fresh-water mollusk of the mid-Atlantic drainage, as check subjects. This work was begun 2 years ago, but the Potomac floods buried the cages which were placed on the bottom, and thus vitiated the tests. It is for this reason that a new set of experiments was started this year, in which the concrete bottom of the cages was replaced by a cypress floor covered with a thin layer of cement. The three cages used in each set of experiments were gathered in a cypress frame and suspended some 18 inches below the surface of the water by means of two metal drums.

These cages have a yard-square bottom and a height of 18 inches. The sides are made of monel metal screening, 20 mesh to the inch, and the top is of the same screening, 10 mesh to the inch. Three sets of three cages each are being used. One of these is placed in the spillway below the hydro-electric plant at Millville, W. Va., another in the Roaches Run Bird Sanctuary, and the third set is placed at the pontoon bridge at Fort Belvoir, Va.

The material used for the experiment consisted of young specimens of the year. One set was gathered above the fall line in Occoquan Creek; another at Dawsons Beach in the Potomac, south of the mouth of Occoquan Creek; and the third was taken from the Chesapeake and

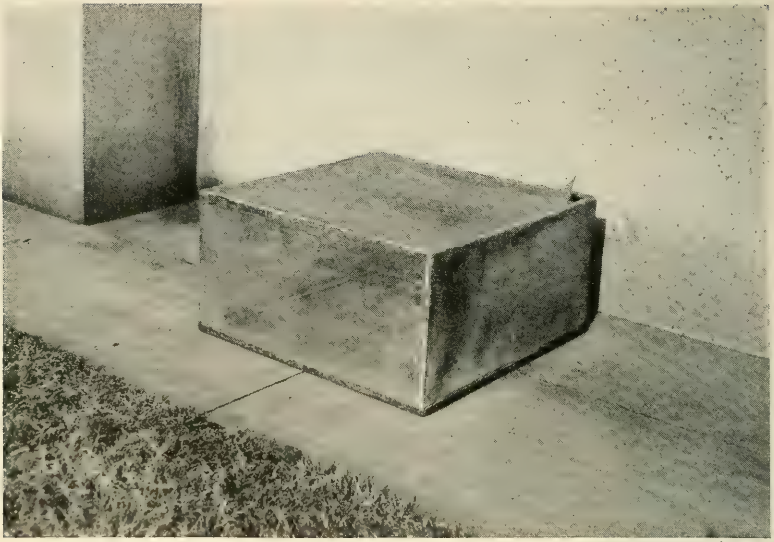


FIG. 72.—One of the cages used in these experiments.

FIG. 73.—Showing the two floats in place from which the sets of three cages are suspended.

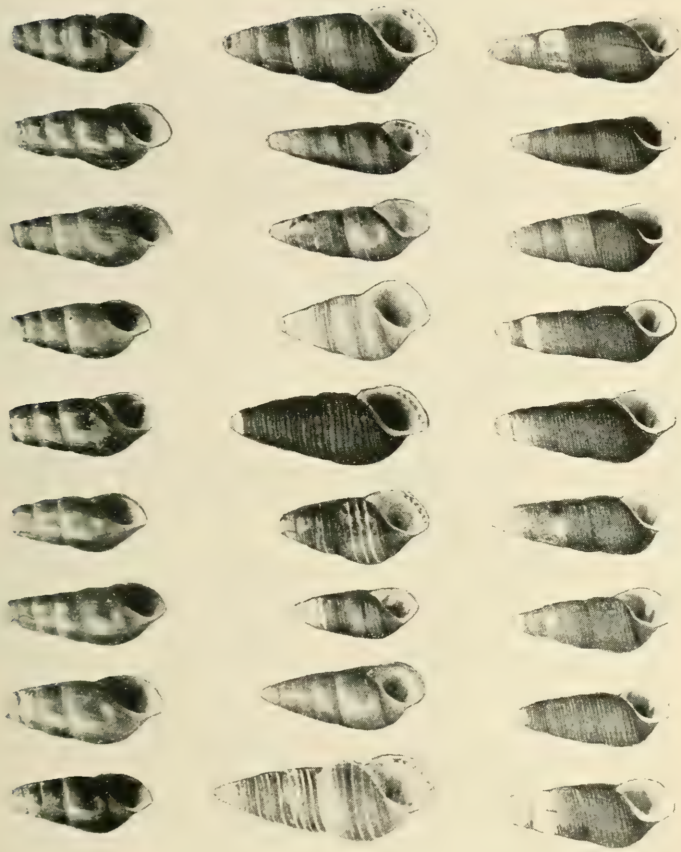


FIG. 74.—*Goniobasis virginica:* Top row, specimens from Occoquan Creek, above the fall line; middle row, specimens from the region about Washington; lower row, specimens from Dawsons Beach.

Ohio Canal below Sycamore Island. Those from Occoquan Creek, above the fall line, are without spiral sculpture and usually olive green, sometimes with a spiral band of brown. They duplicate *Goniobasis* of the Shenandoah River (see the top row of fig. 74). The specimens taken at Dawsons Beach are all spirally lirate, that is, they have uniform spiral threads (see the bottom row of fig. 74). The specimens taken from the Chesapeake and Ohio Canal are not of uniform size, coloration, or sculpture, but vary enormously in all three of these characters, as shown in the middle row of figure 74. These are believed to be hybrids of the mollusks above the fall line of the Atlantic coast, that is, the smooth form and the spirally lirate form of the mouth of rivers just above the influence of salt water, while the intermediate forms, like those about Washington, I believe to be the product of crossing of the other two, i. e., mutations produced by hybridization, a fact to be proved or disproved by the experiment.

In one of the Millville cages we placed 500 tips of the year from Dawsons Beach, in another 500 of the complex occurring at Washington, and in the third 500 each of tips taken above the fall line of Occoquan Creek and Dawsons Beach.

In the Roaches Run Bird Sanctuary we placed 500 tips of the year from Dawsons Beach in one cage, in another 500 tips taken from Occoquan Creek above the fall line, while in a third we placed 500 each from these two localities.

At Fort Belvoir we shifted our cages from the Fisheries Station to the pontoon station where they will be less subjected to shifting ice this winter, and here we placed 500 tips of the year taken above the fall line in Occoquan Creek, in another cage 500 of the Washington complex, and in the third 500 each of the Occoquan and Dawsons Beach specimens.

Although we consider that the experiments of the past 2 years are largely negative, as far as *Goniobasis* is concerned, they nevertheless presented some interesting facts in other directions. For example: In the mud in the cages at Roaches Run and Fort Belvoir we found specimens of the mollusk *Anodonta cataracta* Say, one of which measured 66.2 mm in length, 40.0 mm high and a diameter of 19.3 mm; the glochidium from which this was grown must have been shed by fish upon the cage and fallen through the wire mesh and developed to this size in 8 months. Some of these Anodontas bear as many as eight "annulations", which in the past have been considered indications of annual increments; in other words, the shell in question, which must have been no older than 8 months, would in the past have been said to be 8 *years* of age.

COLLECTING INSECTS ON THE ISLAND OF JAMAICA

By EDWARD A. CHAPIN

Curator, Division of Insects, U. S. National Museum

Because of the inadequacy of the collection of Jamaica insects in the National Museum, I was granted permission to spend 5 weeks on the island early in 1937. The major objective of the trip was to secure beetles of the family Scarabaeidae, but it was also intended that general insect collections would be made. Leaving New York by the United Fruit Company S. S. *Quirigua* and spending a very profitable and pleasant day at the Cuban Agricultural Experiment Station at Santiago de las Vegas en route, I arrived at Kingston, Jamaica, the afternoon of January 27. Preliminary arrangments for lodging and transportation had been made for me by Dr. R. E. Blackwelder, present holder of the Smithsonian's Walter Rathbone Bacon Traveling Scholarship.

Jamaica lies in the Caribbean Sea about 80 miles south of Cuba, is roughly 150 miles east and west, by 50 miles north and south, and offers to the naturalist as wide a range of habitats as is to be found in a tropical island. From sea level with mangrove swamps and marshy savannahs, one may go in a short distance to the tops of the Blue Mountains nearly 7,400 feet above. Much of the land is under cultivation, but there are forested areas in various parts of the island.

During the first half of my stay, headquarters were made at Half Way Tree, a suburb of Kingston. From here by motor car we were able to reach within the day any desired locality in the eastern half of the island. Best collecting grounds were found at Bath in St. Thomas, in Friendship Valley (south of Port Antonio and in the John Crow Mountains), near Manchioneal, and along the Rio Cobre between Kingston and Spanish Town. At Bath we were fortunate in finding a recently felled cotton tree (Ceiba) from part of which a dug-out canoe had been made. On the remains of the trunk and large branches we took many specimens of a large cerambycid (*Steirastoma histrionicum* White) and many other striking Coleoptera. Nearby in the Plantain Garden River many Dryopids were taken from under stones. From the very soft trunk of a tree long dead (probably also a Ceiba) two species of Rhyssodidae, a beetle family not known to inhabit the island, were taken.

Through the generous hospitality of the Bovells of Caymanas Estates Limited, we were permitted to spend 2 weeks with head-

FIG. 75.—The main street of Black River, Jamaica. Not different from most of the smaller Jamaica towns.

FIG. 76.—Maggoty Falls is perhaps the most beautiful of any on the island.

FIG. 77.—This old Spanish aqueduct has been repaired and now serves to carry water from Hope River to Hope Gardens. Hope Gardens, Kingston, Jamaica.

FIG. 78.—Hope Gardens with the office building in the background. Bordering the lawn is a very excellent collection of various species of palm trees.

quarters at their estates of Derry (near Balaclava) and Kensworth (near Newport). From Derry the northern part of the west end of the island was easily worked, and from Kensworth we found many good localities along the south shore from Alligator Pond Bay to Savanna-la-Mar. On the beach grape at Alligator Pond Bay a very interesting and as yet undescribed species of lady bird beetle (*Psyllobora,* n. sp.) was taken in numbers.

The most productive method of collecting that we resorted to was by means of a net fastened to the top of the automobile. While very little could be taken in this way in broad daylight, a truly prodigious number of specimens, mostly of small to minute size, were caught

Fig. 79.—Our car with collecting net in position for use. On our return in the evening from collecting, this net added many thousand specimens which would otherwise have been missed.

each day between the hours of five and seven in the evening. For an example, the net was used on the road one evening from Spanish Town to Half Way Tree, a distance of 13 miles. After discarding the fragile specimens which were broken by impact with the net, we saved 3,953 specimens of beetles, representing 146 species distributed among 34 families. Many of these species were previously not known from the island and some are certainly new to science.

Although insects were relatively scarce because of the drought conditions which prevailed during our stay, we succeeded in securing some 50,000 specimens of various orders, representing about 1,000 species. Three species of scarabs new to science were found, as well as several which were not previously represented in the collection of the U. S. National Museum.

THE BUTTERFLIES OF VIRGINIA

By AUSTIN H. CLARK
Curator, Division of Echinoderms, U. S. National Museum

The " invisible butterfly " was present in Virginia in great numbers during the past summer, and Mrs. Clark and I obtained records from no less than 50 cities and towns in 16 counties, all in the coastal plain. But never once did we see the butterfly.

The caterpillars, however, were abundant on cannas, and in some places they had reduced the upper leaves to midribs only. Even the caterpillars are not visible on casual observation. You have to look for them under portions of the canna leaf turned inward and fastened down to the upper surface. Pry up this leaf-flap, and there is the caterpillar—a pale, rather sickly looking, singularly unattractive caterpillar. These caterpillars, we found, had escaped the notice of the people whose gardens we examined. They had seen the damage to their cannas, but did not know just what the culprit was.

From the caterpillars it is very easy to raise the butterfly. This is a rather large, dull-colored skipper called the Brazilian skipper, remarkable for its exceedingly swift and powerful flight. It lives throughout the American tropics, where it is a pest on cannas and on arrow-root, and occurs normally northward to South Carolina. But it has a penchant for migrating, sometimes in great numbers, and occasionally turns up as far from home as New York City or Long Island. Whether the Brazilian skipper occurs regularly in eastern Virginia in reasonable numbers or whether it visits the State only at intervals is not known. This is a point to be decided in the future.

Butterflies have a disconcerting way of turning up in unexpected places. One of the finest of Virginia's butterflies, the Diana fritillary (*Argynnis diana*) was heretofore supposed to be confined to the western mountains, but Carroll M. Williams took it on the eastern coastal plain, and Herbert Wagner found it in the Dismal Swamp. The magnolia swallowtail (*Papilio palamedes*), very common in the eastern coastal swamps, appeared this summer in several unusual places, for instance near Warrenton and at Washington, D. C.

This summer's work, and the kindness of friends, particularly Prof. Ellison A. Smyth, Jr., and Carl W. Gottschalk of Salem, resulted in the addition of six species and subspecies to the list of Virginia butterflies, making a present total of 139. The most interesting was the

FIG. 80.—Typical Virginian habitat of the sub-arctic skipper, *Pyrgus centaureae,* at Rocky Run. The entomologists are Ashley B. Gurney, Richard P. Dow, Harald Rehder, Miss Grace Sandhouse, and Mrs. A. H. Clark.

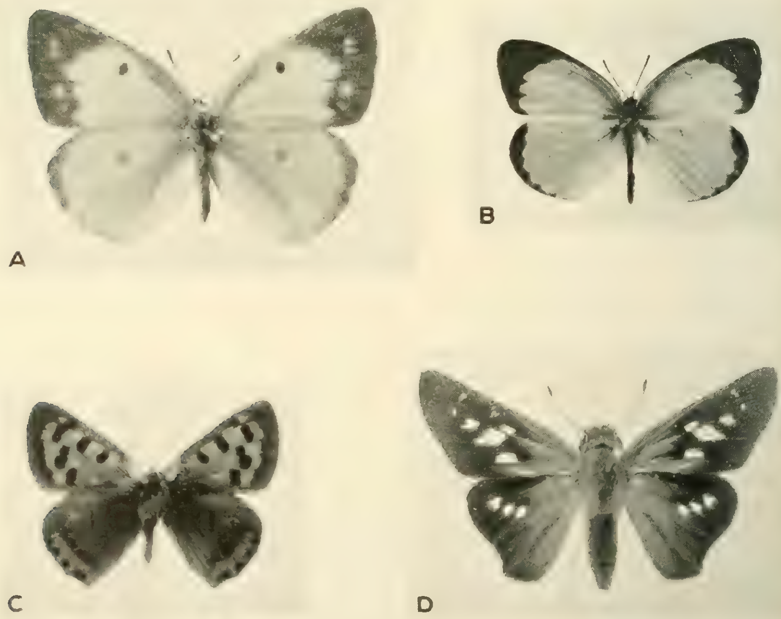


FIG. 81.—Two common mud-puddle butterflies; A, *Colias philodice philodice* (female); B, *Terias lisa* (male). C, the common copper, *Lycaena phlaeas hypophlaeas;* D, the "invisible butterfly," *Calpodes ethlius.*

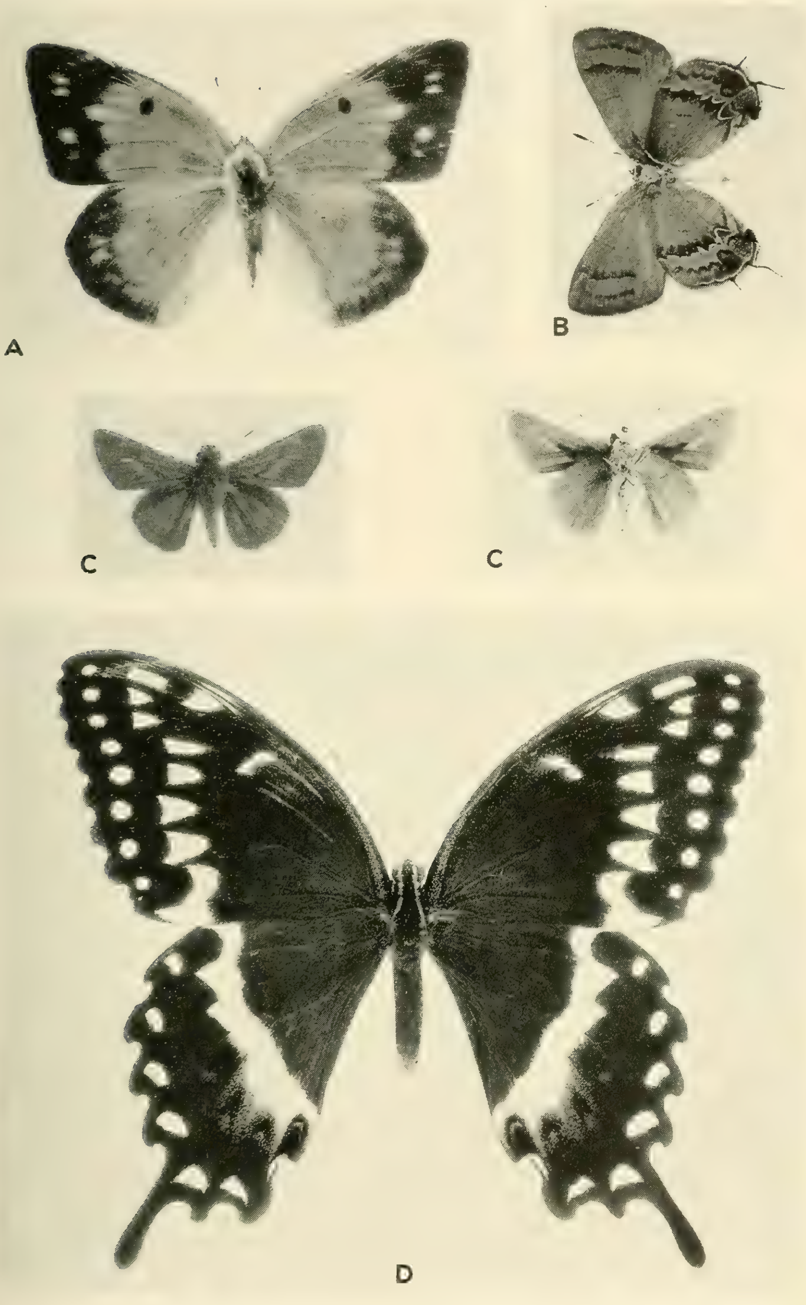


Fig. 82.—A, the orange clover butterfly, *Colias philodice eurytheme* (female); B, the red-banded hairstreak, *Strymon cecrops,* under side, × 1½; C, the two-spotted skipper, *Atrytone bimacula,* upper (left) and under (right) sides; D, the magnolia swallowtail, *Papilio palamedes.*

two-spotted skipper (*Atrytone bimacula*)—a very inconspicuous and decidedly rare species thrilling only to a specialist—which we took in Augusta County.

Strange varieties of butterflies are always interesting to get. This summer Mr. Gottschalk sent us a red-banded hair-streak (*Strymon cecrops*) in which all the bright red on the under side is replaced by yellow. It is strange that in a butterfly so abundant as this no one has previously reported this variety. This corresponds to the rare variety of the American copper (*Lycaena phlaeas hypophlaeas*) in which the red is replaced by yellow. We captured the first known Virginia specimen of this in Fairfax County on May 2.

Much has been written on the changes in customs of human populations resulting from migrations from one region to another, but few have paid any attention to changes in the habits of immigrant butterflies. Although it is true that most immigrant butterflies do not change their habits—noticeably at least—a few of them do.

Some years ago when the western orange clover butterfly (*Colias philodice eurytheme*) was becoming established in Virginia, and it and the native yellow form (*C. p. philodice*) were about equally common, it was noticed that although the males of the yellow one were much given to sitting on mud in groups often of large size, their orange relatives never did this. In the companies sitting on the mud there were sometimes one or two individuals with a slight flush of orange (the form *ariadne*), but never a full-colored orange one.

During the past summer the immigrant from the West appears to have learned the pleasures of sitting on mud and sucking up the moisture. We noticed this in several places in the western portion of the State. On August 14, 1937, near Moscow in Augusta County, we saw about 35 males of the orange clover butterfly sitting in a compact group on mud in a road, together with three males of the yellow native and a few males of *Terias lisa*, these last at some distance from the others.

So far as this region is concerned, this is a rather remarkable change in the habits of this butterfly. It appears to be becoming thoroughly adjusted to its new environment and to be adopting the habits of its local relative.

There is much to learn about the butterflies of any region besides the simple fact of their occurrence.

EXPLORING THE LAKES OF NORTHERN WISCONSIN

By PAUL S. CONGER

Custodian, Section of Diatoms, U. S. National Museum, and Research Associate, Carnegie Institution of Washington

Wherever natural waters occur, microscopic life may be expected in abundance, with diatoms (those one-celled or colonial plants with boxlike cell walls of glass or silica) almost inevitably present. But some waters, depending on their nature, are more productive than others. To find a place where such waters of varying character, with consequent diversity of life, are within easy reach of each other is not simple, but northern Wisconsin is just such a place. During the latter half of the summer of 1937 I was able to continue collection of diatoms, as in two previous summers, among the lakes here, in cooperation with the University of Wisconsin, and the State Geological and Natural History Survey.

The region has had a peculiar history of exploration. Visited first by the French Jesuits in conquest of new domains, then again around the turn of the century by the great lumber barons in conquest of rich virgin forests, it was left, a barren cut-over and burned-over waste, to trappers and adventurers. In recent years a wide-awake conservation commission has realized that it has all the attributes of a great summer playground—good climate, beautiful lakes, fishing, quiet, and seclusion—and is taking timely and energetic steps to protect it as such.

Half a century ago Dr. Edward A. Birge, pioneer biologist of the University of Wisconsin, visited the lonely northern woodland and lake region by horse and buggy, over rough logging roads, and saw in these lakes a rich territory for a far-sighted limnological program. Some 12 years ago, with his associate Dr. Chancey Juday, he again visited the region, setting up a laboratory at Trout Lake in a deserted bath house where they could make a few observations for comparison with their studies of southern Wisconsin lakes. But the region proved so varied and so interesting that they stayed on and on until their laboratory and its staff grew to include five buildings and a personnel of chemists, physicists, and bacteriologists, as well as biologists.

Nature here seems to have planned an ideal layout for the student of fresh-water biology. With the Trout Lake laboratory as a focus, within a radius of 30 or 40 miles, there are in the one county reputedly

FIG. 83.—Shore line and buildings of the Trout Lake Biological Laboratory.

FIG. 84.—Dr. Birge (right) and Mr. Kerst taking solarimeter readings.

FIG. 85.—Forestry Bog, a soft-water closed bog.

FIG. 86.—Trout Lake, a medium hard-water drainage lake.

more than 800 lakes, more water area than land. In this, one of the world's most concentrated lake districts, one may conveniently visit several lakes in a morning and study his materials in the afternoon.

But what, after all, is so interesting about a lake? To the vacationist who frequents this region, a lake is a fairly sizeable body of water, fixed and unchangeable year in and year out, which should yield whatever type of fish he may choose to angle for. To a biologist, on the other hand, a lake is a highly particular and sensitive body of water, dynamic and variable, and teeming with life of a very unstable and changeable nature, no more capable of producing a bumper crop of fish unsuited to it than a sandhill farm is capable of producing a heavy crop of corn. And no two lakes are precisely alike; each has a personality of its own.

The kind of fish depends upon the kind and abundance of a myriad of smaller organisms upon which they feed, and these in turn upon the kind and abundance of small plants serving them as food, the plants upon chemical food materials dissolved in the water, and all of these upon the configuration of the lake basin, the surrounding soils from which its waters drain, the amount and quality of solar radiation for plant growth, and many other complicated factors.

In years of diligent work Drs. Birge and Juday have analyzed and tabulated on readily accessible cards the chemical constituents of 540 of these lakes, thereby giving intimate and comparative knowledge of their characteristics, and aiding selection of particular lakes for special experiments; as it were, a vast series of aquaria already set up for experimental study.

With this well-adapted background, I have thus far obtained diatom collections from about 150 of the lakes, representing all diverse types. These collections, from lakes often superficially very similar, show a considerable variety of species, with evidence that "survival of the fittest" plays an important rôle; often slight and subtle differences in proportion of chemical substances in the water, or in some physical factor such as temperature or light penetration, favor one species and give it dominance over another.

Some lakes are probably much the same today as the day they were formed, others have evolved to the stage of a nearly filled bog. Sometimes the latter are the more interesting, but often the most inaccessible. Frequently we could not get a light skiff through the scrub pine and over the bog margin to a lake, and it was preferable to use an inflated rubber boat somewhat resembling a huge doughnut. Footing in it was always insecure, and one stroke of the short oar would spin it

FIG. 87.—The rich and various diatom flora of Ink Pot Lake, a shallow, medium hard water, alkaline, drainage lake.

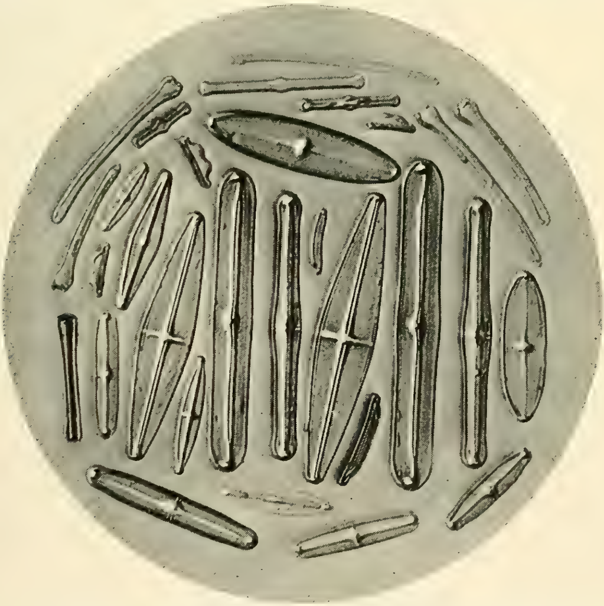


FIG. 88.—The meager and restricted diatom flora of Forestry Bog, a very soft water, highly acid, dark-colored closed bog.

around like a top. Judging by the puzzled and amused expressions of onlookers, when we embarked within public view, our craft must have been picturesque, to say the least, as it pursued a zig-zag course over the surface of a boggy lake under the erratic control of two-half-dressed limnologists, huddled in the center and leaning over the inflated pontoon to take water samples in bottles, pulling a little silk net behind, and lifting mud from the lake bottom in a small brass bucket.

Uncompleted examination of the collections indicates that in general diatoms flourish much more prolifically in the drainage than in the seepage lakes, in the hard-water than in the soft-water lakes, and in alkaline than in acid waters. The very boggy lakes, high in organic matter and very acid, yielded few diatoms.

I was so deeply impressed, on a number of occasions, with the striking differences in microscopic life in closely adjacent and apparently similar lakes, which differed only in proportions of dissolved substance by a few parts per million, that I made a point of noting within a period of a few days about August 20 the following lakes, " in bloom " with the corresponding organisms:

Turtle Lake (Vilas Co.)	*Lyngbya, Anabaena*
Fish Trapp Lake (Vilas Co.)	*Fragilaria crotonensis*
Harvey Lake (Vilas Co.)	*Fragilaria crotonensis*
Pier Lake (Oneida Co.)	*Fragilaria crotonensis, Asterionella,* rotifers
Grassy Lake (Vilas Co.)	Rotifers, Nauplii. (No diatoms.)
Sweeney Lake (Oneida Co.)	*Melosira granulata, Stephanodiscus niagarae*
Midge Lake (Vilas Co.)	*Dinobryon, Ceratium* (2 species)
Scaffold Lake (Vilas Co.)	A very minute blue-green alga species

Why the differences? That is the problem. It is scarcely conceivable, with lakes as old as these and so close to each other, and with diatoms and algae as abundant and easily distributable as they are by birds, water currents, winds, and other agencies, that all the different species would not have had full opportunity for widest distribution in all the lakes. To determine the reasons why some organisms abound to the exclusion of others is a delicate and complex problem. The job of exploring Wisconsin lakes is scarcely more than begun.

ANTHROPOLOGICAL EXPLORATIONS ON THE ALEUTIAN AND COMMANDER ISLANDS

By ALEŠ HRDLIČKA

Curator, Division of Physical Anthropology, U. S. National Museum

Three memorable months were spent in the summer of 1937 at several points in southern Alaska, on a series of the Aleutian Islands in different parts of the chain, and on the Commander Islands. Owing to stormy weather and fogs the trip was strenuous and much time was lost, but through good fortune and the invaluable aid of the Coast Guard, more was accomplished than had seemed possible during the earlier part of the trip.[1]

The expedition included six volunteer students: Sydney Connor, of the Girard Institute and the University of Pennsylvania; Paul Gebhardt, of the University of Arizona; Paul Guggenheim, of the Washington University Medical School, St. Louis; Alan May, of Wenatchee, Wash.; Stanley Seashore, of the University of Iowa; and Walter Wineman, of the Indiana State Teachers College. These men took part in all the search and work and deserve much credit for what was accomplished, particularly the two "veterans", May and Connor, who were also with me in 1936.

[1] The chief credit and thanks in this connection are due to Commander L. C. Covell, at Washington, D. C.; Capt. R. W. Dempwolf, at Seattle; Capt. H. R. Searles, the head of the Alaska Division of the Coast Guard, and to Capt. P. F. Roach, with the officers and crew, of the cutter *Duane*. Grateful acknowledgment for effective aid is further due to Capt. F. A. Zeusler, of the cutter *Northland;* to Capt. N. G. Ricketts, officers and crew of the cutter *Talapoosa;* to Lt. A. J. Carpenter and others of the cutter *Morris;* and last but not least to Mrs. R. W. Dempwolf and Mrs. H. R. Searles, both of whom gave wholehearted assistance. Thanks are further hereby given to Capt. Robert B. Carney, Dr. W. H. Harrell, and other officers of the U. S. S. *Sirius,* who transported the members and collections of the expedition from Unalaska to Seattle; to Gordon Jones, Superintendent of the great Alaska Packers Cannery at Larsens Bay, Kodiak Island; to Mr. and Mrs. E. K. Pedler, of the Alaska Commercial Company at Unalaska, who aided us in the friendliest manner in every possible way; and to many friends, white and also native, who assisted us with information and in many other ways. Cordial thanks finally are due to the Russian authorities at Nikolsk, Bering Island, for their courteous and helpful treatment of the expedition. Without the aid and good will extended to us on all sides but little could have been accomplished in the uninhabited, partly still uncharted and stormy regions that were visited.

Fig. 89.—The harbor and approach: Wisslow Island.

Fig. 90.—Hunting for burial crevices: Wisslow Island.

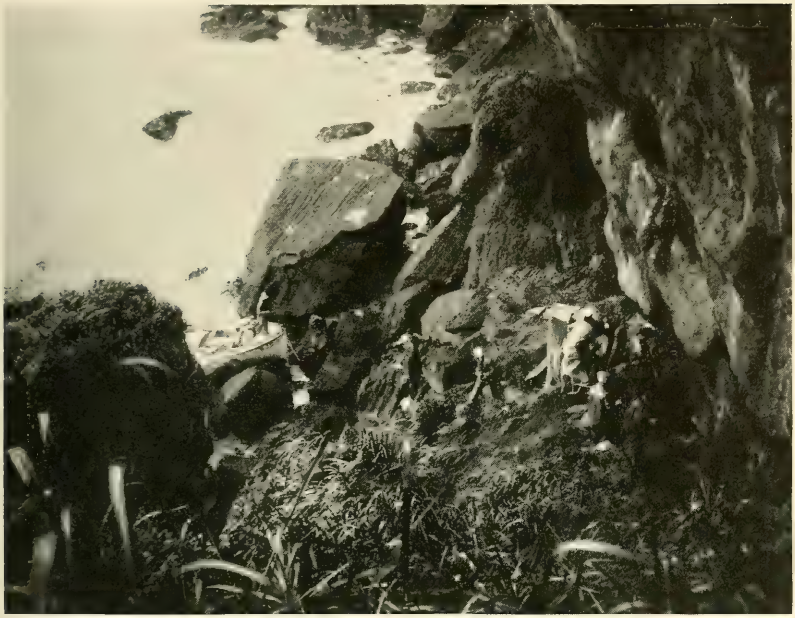


FIG. 91.—Mummy shelter, Shiprock (Umnak Pass).

FIG. 92.—"Hell's Kitchen," Amlia.

The expedition started from Seattle May 21, 1937, on the cutter *Northland;* transshipped at Juneau to the *Talapoosa;* changed at Unalaska to the *Morris,* from which it explored Unalaska and the Four-Mountain group; shipped again on the *Talapoosa,* on which it reached Attu and the Commander Islands and from which it eventually (July 17) was placed on the uninhabited and little-known island of Agatu, in the westernmost American group, where 22 days were spent in excavation. On August 8 the party was taken from Agatu by the cutter *Duane,* visited with this vessel the islands of Attu, Tanaga, Ilak, Adak, Umnak, and Shiprock, and returned August 20 to Unalaska. There we were met by the Navy transport *Sirius,* to which we transferred the collections, and on the morning of August 21 left for Seattle.

Scientifically, the work on Agatu Island and that during the last 12 days of the journey proved the most remunerative, being topped on August 19, the last day of the trip, by the discovery of a hitherto unknown cave, or rock shelter, on Shiprock Island in the Umnak Pass. The anthropological materials collected during the 3 months filled 51 boxes and barrels; but even more important were the determinations made possible by the recovered skeletal remains.

The results indicate the existence throughout the Aleutian Islands of a separate type of people antedating the Aleut. These were an oblong- and medium high-headed type, occasionally somewhat eskimoid, but more commonly Indian-like. Their latest strains admixed more or less with the broad- and low-headed Aleut.

The occupation of the islands by the earlier element, as shown by the deposits, was considerably longer than that by the Aleut, and the people at one time must have been rather numerous. Both types extend throughout the chain, but the Aleut overlay thins out as one proceeds from the Peninsula westward. Some of the blood of the older oblong-headed element evidently still exists in a few of the mixblood survivors on the islands. It is the same type as that found in the lower deposit or stratum on Kodiak Island. All the old sites on the Aleutian islands probably belong to this type, but generally contain a cover, an adjunct, or intrusive burials of the characteristic later broadheads, or Aleut.

Since 1926, the beginning of these explorations in Alaska, it has been clear that there were two physically distinct varieties of the Eskimo, and it now is seen that at one time there were also two varieties of men in the Aleutian Islands. Moreover, neither of the types in the Aleutians were identical with either of the true Eskimo

FIG. 93.—Vicinity of Hot Cave, Kagamil.

FIG. 94.—Mount Cleveland, Aleutian Islands, 1937.

types, and though somewhat related to them, they were at least equally related to the Indian.

The far Northwest of the American continent contains thus no less than five distinct though basically related strains of the native man. These are: 1, the long- and high-headed Eskimo of the Seward Peninsula, Barrow, and generally eastward to Labrador and Greenland; 2, the broader- and medium- to high-headed Eskimo of East Cape, the Diomedes, Norton Sound, the rivers from Yukon southward and the proximal parts of the Peninsula; 3, the broad- and low-headed late Aleut, extending from the central parts of the Peninsula and the Aleutian chain, some of whom still live in those regions; 4, the oblong-medium to high-headed pre-Aleut, in individuals somewhat Eskimoid, in others more Indian in their characteristics, extending originally over all the Aleutian Islands and to Kodiak; and 5, the Indian tribes of the great rivers, Cook Inlet, and farther eastward. These Indian tribes themselves present two or three different strains: the oblong-headed Shageluks, the interior Tinneh (Dene) tribes, and the Thlinkits or Kolushans of the Gulf region and southeastern Alaska.

There are no clear lines of demarcation, however, between these different types; their averages, especially in the male adults, differ distinctly, but their extreme measurements connect, especially in the children and women. This is particularly true of the broad-headed Eskimo, the late Aleut, and the Cook Inlet and more eastern Indians. The whole region impresses the observer as a human "nursery" constituted by several related strains of Asiatics, from which either the pronounced Eskimo or typical Indian could readily have developed. The pre-Aleut people of the islands could perhaps be conceived as a more protean stock, from which either true Eskimo or true oblong-headed Indians may in time have arisen. It is in all probability the same strain as that found in the older layers of the mounds at Vancouver and elsewhere in the northwestern regions. The archeological indications are that this strain moved from the west eastward, and not the reverse as seems to be the case with the Aleut.

In addition to the above the expedition found, on Agatu Island, a new chipped-stone industry, belonging to the pre-Aleut people; enlarged considerably the cultural materials from Amoknak Island, Unalaska; obtained new types of lamp and of stone and wooden objects from Kashega and other places; added a series of mummies with specimens of the decorated weaving art in matting from Shiprock, Umnak Pass; and examined sites and made collections at Yakutat, Nuchek, Wisslow Island, Chernovski (Unalaska), Kashega (Unalaska), Umnak, Kagamil, Amlia, Atka, Adak, Tanaga, Ilak, Attu,

FIG. 95.—Shiprock: A mummy with its coverings.

FIG. 96.—Shiprock: A mummy without its coverings.

and Bering Islands. On Kagamil, which yielded numerous burials last year, the two old caves were revisited and all remaining material recovered, and two new rock-shelters containing old burials were discovered.

The Commander Island visit, the main object of which was to find whether or not these islands had been inhabited before the Russians, and thus whether or not they may have served as a second bridge for man's coming from Asia, was not conclusive one way or the other. The Russians there were all recent and had not given any attention to possible old sites; the few natives that could be consulted were originally brought over from the Aleutian Islands, are Russianized, and knew nothing of what we were after; and only the mouth of one stream, that at Nikolsk, could be examined in the short time at our disposal, and that was so affected by erosion that no idea could be formed as to what the conditions may have been in that vicinity a few hundred years ago. The islands had no native population when reached in 1741 by the Russians. Whether or not there are any old sites in the islands may only be determined by a survey of the vicinity of the mouth of every likely stream on both of the islands. This task could not be carried out by us because of our ship's lack of fuel. Considering that the highlands of Bering Island could be seen on a clear day from the nearest highlands on the coast of Kamchatka, and that there was about the two islands an abundance of fish, sea otter, seal, and sea cow, with many foxes on land, it would be very strange if the islands, even though colder than the Aleutians and stormy, had not been reached and for a period at least peopled by the Asiatics, who may then have discovered and moved over to the Aleutians. However, the facts of the case remain to be determined.

ARCHEOLOGY OF THE VIRGIN ISLANDS

By HERBERT W. KRIEGER
Curator, Division of Ethnology, U. S. National Museum

On a recent visit to Washington, Robert Nichols, Superintendent of Agriculture of St. Thomas, Virgin Islands, informed Dr. Wetmore, Assistant Secretary, Smithsonian Institution, of a large shell mound on the Island of Anegada, the most northerly of the British Virgin Islands. As a result of this information, an expedition was organized to explore the mound, the scientific objective being a comparison of the Indian relics to be recovered there with the large collections obtained by previous Smithsonian expeditions from the Bahama Islands, Cuba, Jamaica, Haiti, Santo Domingo, and Puerto Rico. The writer sailed October 14 from New York, and returned at the close of the year.

Since the immediate objective was an exploration of the Anegada mound, the cooperation of the United States Coast Guard Service was obtained within a few days after arrival at the beautiful port of Charlotte Amalie, St. Thomas. Captain Walsh of the Coast Guard boat, the *Marion*, and his entire crew were quite willing to embark on the expedition since they had not heretofore sailed in the British waters immediately adjacent to Anegada.

Many fertile suggestions were forthcoming from officialdom in Charlotte Amalie regarding the proposed sojourn on Anegada, for many dark tales had been told regarding its native population, whose naïve occupation of steamer wrecking is still listed in current encyclopedias. No one at Charlotte Amalie had ever seen Anegada, and stories of shifting and disappearing lighthouses, of shoals, hulks of wrecked freighters, and of the mysterious splendor of house furnishings of a marine flavor in the huts of the leading citizens of Anegada were freely circulated among the credulous members of our expedition from Captain Walsh down to the courtly cook. Nevertheless, all were anxious to go, including most of the small American colony of Charlotte Amalie.

En route to Anegada, an official call was made on the Commissioner of the British Virgin Islands, at Road Town, on the Island of Tortola. The Commissioner was highly pleased with the prospect of placing Anegada on the map archeologically. Mr. Roy, Agricultural Superintendent of the British Virgin Islands, who was thoroughly familiar

Fig. 97.—In 1869 William M. Gabb discovered extensive kitchenmiddens in caves on the south shore of Samaná Bay, eastern Santo Domingo. Stimulated by this discovery, and with the financial support of the late Dr. W. L. Abbott, archeological expeditions have been dispatched by the Smithsonian to explore further the Samaná caves, also to investigate cultural remains on other islands of the West Indian archipelago. The expedition to the Virgin Islands, described in this article, is the most recent.

FIG. 98.—Captain Walsh, of the U. S. Coast Guard cutter *Marion* approaches Anegada's shore by walking on the ocean floor which is here as smooth and firm as a pavement. The water is too shallow even for the ship's boat.

FIG. 99.—The reception committee at Anegada, comprising a good share of the entire population, waited while we adjusted trousers and foot gear after our journey ashore through the ocean shallows.

FIG. 100.—Mr. Roy, Agricultural Superintendent of the British Virgin Islands, standing atop the mound of conch shells near the eastern end of Anegada.

with the native population and the geography of Anegada, joined the expedition at Road Town.

On his second voyage to the West Indies in 1493, Christopher Columbus, after pausing at the islands of Dominica, Guadeloupe, St. Martin, and St. Croix, long enough to give them their names, which they have retained to the present day, observed north of low-lying St. Croix a formation of rocks, islets, and mountainous islands " too numerous to mention " even to this facile explorer. His imaginative brain immediately visualized this massed archipelago as symbolizing St. Ursula and her 11,000 virgins—hence the name Virgin Islands. He singled out the Island of Tortola as worthy of a special name, since it appeared to be more mountainous—suggesting great mineral deposits, which after all, was a major objective of this First Explorer.

The island of Anegada was approached cautiously at half speed because of the extensive shallows. At a distance of 5 miles from the shore the *Marion* dropped anchor in 4 fathoms. Anegada, a low-lying coralline formation, was but dimly visible. The *Marion's* boat was launched and loaded with supplies. Practically the entire population of Anegada, embarked in a nondescript fleet of sailboats and rowboats, came out to meet us, to " see that it was done properly ", as we learned later from the colored British Government Agent. He did not explain what he meant by " it." A lookout in the only tall tree on the island had reported the *Marion* aground. Native joy was soon dampened when the lookout's error was discovered.

No time was lost in reaching the shell mound, which proved to be a very large one built up almost entirely of conch shells, *Strombus gigas*. The thorn forest which covers most of Anegada hid from our view any other evidence of aboriginal occupancy. Since the excavating of a mound practically devoid of any cultural material other than discarded conch shells was impractical, work here was restricted to making measurements and photographs of the mound. A brief survey of the island was made in an attempt to locate other middens that might be richer in cultural material, and selection was made of pottery, shell, and polished stone implements gathered at random from the surface. All of this consumed a few days' time, after which the expedition returned to Road Town.

Mr. Roy, who was very helpful throughout, suggested a trial excavation of the Indian midden just east of Road Town. With his help, laborers were obtained and the highest part of the midden was trenched. The results were striking in that the cultural objects obtained were practically identical with material collected by previous Smithsonian expeditions from Arawak village sites in Santo Domingo,

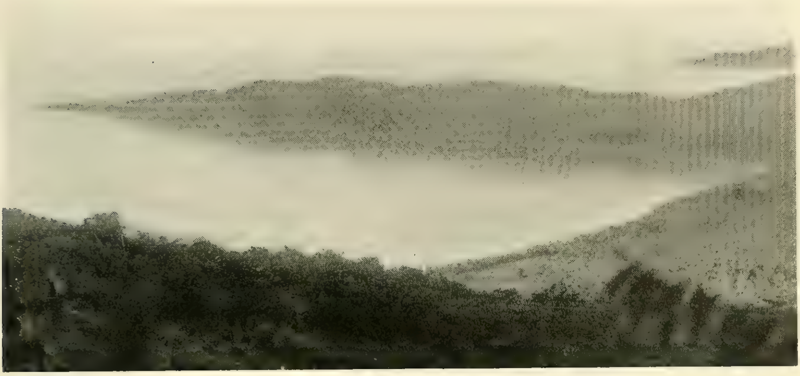


FIG. 101.—Magens Bay and valley on the north central coast of St. Thomas as seen from Mafolie, a village near the mountain summit. In the valley shown at the right is located one of the most extensive village sites of former Indian inhabitants in the West Indies.

FIG. 102. Completing the trench of excavation No. 1 at Magens Bay, St. Thomas. This site is at the extreme northeast end of the valley as seen in figure 101.

FIG. 103.—Examining debris from cut No. 2, the middle portions of excavation No. 1, at Magens Bay, St. Thomas. Hand sieves were used by laborers selected from the French settlements on the island.

thus contrasting markedly with material to be later excavated at St. Croix and St. Thomas. Although the time consumed in the study of the Anegada shell midden and the Road Town kitchenmidden was brief, the scientific results obtained were definite. The position of the Road Town midden as one of the older in the aboriginal cultural sequence of the Virgin Islands became evident. Thus the archeological chronology of aboriginal cultural remains in the West Indies finally assumed form.

The next phase of the work of the expedition was the excavating of prehistoric aboriginal Indian village sites on the island of St. Thomas. This island is mountainous and presents a radically different aspect from that of flat, coralline Anegada. St. Thomas and the other Virgin Islands proper belong geologically to the ancient submerged continent of which mountainous Puerto Rico and the still higher Santo Domingo constitute the main axis. Shore lines present evidence of continued subsidence. The writer found quarters at the Government Hotel which clusters around the tower of the infamous pirate Bluebeard, the subject of many fabricated legends despite the ponderous facts of the many rusted cannon and battlement stanchions.

It was a pleasant daily morning journey indeed to labor upward in a 1928 Marquette automobile over the hogback of the mountain range just back of and above sleepy Charlotte Amalie and then downward along the steep northern slope into the broad, flat valley which terminates in the waters of Magens Bay. Much of this area is the property of A. S. Fairchild, whose residence, Louisenhöj, rests astride a peak of the central mountain massif. Mr. Fairchild kindly gave permission to excavate on his land and cooperated in every way possible to make the undertaking a success.

The writer, whose previous experience in active investigation of West Indian archeology was limited to the islands west of St. Thomas, found at Magens Bay archeological specimens strikingly dissimilar to the pattern of the Arawak culture of Santo Domingo. It became at once apparent that cultural infection must have spread northward from the islands of the Lesser Antilles which stretch southeastward 500 miles or more to the South American mainland. This made possible a comparison of the older Arawak (Taino-Igneri) culture trait complex as typified in a midden at the extreme northeastern end of Magens Bay valley with a later, more characteristically South American culture embodied in a series of nearby middens south and west of the older Arawak site. Objects typical of each culture provided ample data for a definite determination of aboriginal culture sequence in the West Indies. The presence of red paint on the pottery vessels recov-

FIG. 104.—The west end of the island of St. Croix from the open roadstead of Fredericksted. Montpellier Mountain in the background. Mountains such as this are visible to one standing at sea level in St. Thomas, 40 miles north. The South American Arawak Indian could always see one or more islands of the Antillean chain as he migrated northward.

FIG. 105.—The sugar central at Bethlehem, centrally located on the southern plains of St. Croix.

FIG. 106.—The denuded mountain slopes of St. Thomas near Charlotte Amalie. Slave labor once cultivated sugar cane on land now considered too rough and arid.

ered in the middens of the southwestern section of the valley is striking evidence of cultural infection. Painted pottery in the West Indies is unknown west of the Virgin Islands, with the exception of red painted ceramic wares in the vicinity of Ponce, Puerto Rico, and white kaolin slipware from northern Santo Domingo in the vicinity of Monte Cristi.

After an intensive archeological investigation of the Magens Bay site, the writer undertook a survey of the island of St. Croix. In this project he received the active direction and cooperation of Harry Taylor, Administrator of the island, an enthusiastic student of archeology, who hopes to develop for the Insular Government a museum featuring the prehistory and natural history of the Virgin Islands.

The largest Indian village ruins on St. Croix are located on the west side of an inlet and lagoon which indents the north shore of the island at its approximate center. Here at the mouth of Salt River, really a streamlet, but always providing an abundance of fresh water, was the tribal seat. Excavations were undertaken at this major site, also at other middens notably at Fair Plain, midway on the south coast, at Prosperity, diagonally opposite the Salt River site on the west end of the island, and finally at Ackles on the southwest coast near the west-end Saltpond on the Camporico estate. Excavations made at each of these sites afforded new data on the daily life of the prehistoric Indian inhabitants of St. Croix and served to verify tentative conclusions based on the finds at Magens Bay, St. Thomas. Outstanding at each site was the overwhelming evidence of cannibalism. Complete human skulls and skeletal remains in quantity were mingled with turtle, bird, and fish bones in the deep ash beds surrounding the primitive hearths.

The German historian Oldendorp is authority for the statement that the Virgin Island Indians were exterminated about 1550 at the order of Carlos V of Spain. Perhaps Carlos V was in the right in ordering Indians addicted to such practices to be treated as enemies and to be exterminated, but we can only wish he had delayed the execution of this order until an anthropologist could have studied them as a living group. Cannibals sometimes are lovable people, and it is conjectured that such a study might have shown the anthropologist that these primitive St. Crucian cannibals were, as a part of their defense mechanism, exercising a culture trait borrowed from their enemies—the Caribs.

INAUGURATING AN ARCHEOLOGICAL SURVEY IN KANSAS

By WALDO R. WEDEL

Assistant Curator, Division of Archeology, U. S. National Museum

Systematic researches in Great Plains prehistory during the past decade have thrown much light on what has long been one of the least known archeological areas in North America. It is now established that throughout much of this region—the " Great American Desert " of the early European explorers, bison-hunting Indians were preceded before the coming of the white man by successive sedentary peoples who subsisted primarily on the cultivation of maize and other crops. The arts and crafts of these earlier peoples varied from locality to locality, and even in the same area there were temporal differences. As yet it has not been possible to determine in every case just how these differences came about. Students of prehistory are still uncertain as to the connections which formerly existed between the tribes in the northern Plains and the higher centers of culture on the lower Arkansas and Red Rivers. Equally perplexing is the relationship between archeological cultures in the Mississippi valley and those of the western Plains. One reason for the archeologists' uncertainty in these and like problems is the almost complete lack of reliable information on the prehistoric remains of Kansas, which lies in the very heart of the Great Plains. To bridge this gap in our anthropological literature plans were formulated for a State-wide archeological survey of Kansas to be carried on by the United States National Museum. As the initial step in this projected program, the writer spent 3½ months from May to September in reconnaissance excavations in northeastern Kansas and adjoining portions of Missouri. Investigations included three village sites along the bluffs of the Missouri River above Kansas City and two in the Kansas valley near Manhattan.

During the month of June excavations were carried on at a small but prolific site on Line Creek about 5 miles northwest of Kansas City. This had been partly destroyed by recent road-building operations, but in the remaining undisturbed portions evidences were found of a prolonged and intensive occupation by a horticultural people who used it for a camp site before the arrival of Europeans. These people made pottery of two distinct kinds. One was in the form of large pointed-base jars the outer surface of which was often roughened by impressions from a cord-wrapped implement (fig. 107, *E, J*). In form and type of decoration this pottery is comparable to that classified as

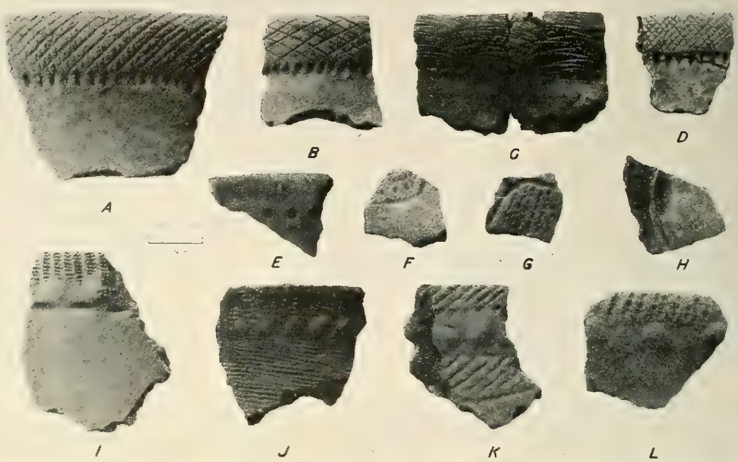


FIG. 107.—Potsherds from the prehistoric Renner site on Line Creek near Kansas City, Mo.

FIG. 108.—Miscellaneous artifacts from the Renner site near Kansas City, Mo.

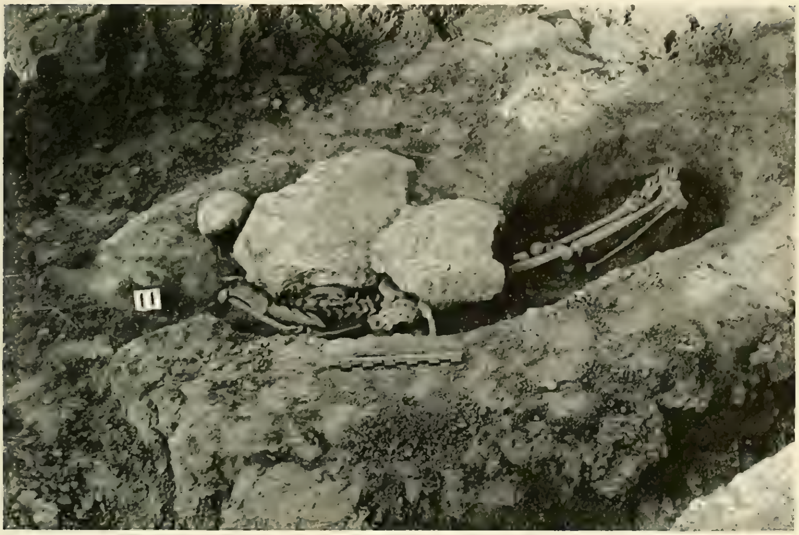


FIG. 109.—Stone-covered burial, possibly early Kansa, near Doniphan, Kans.

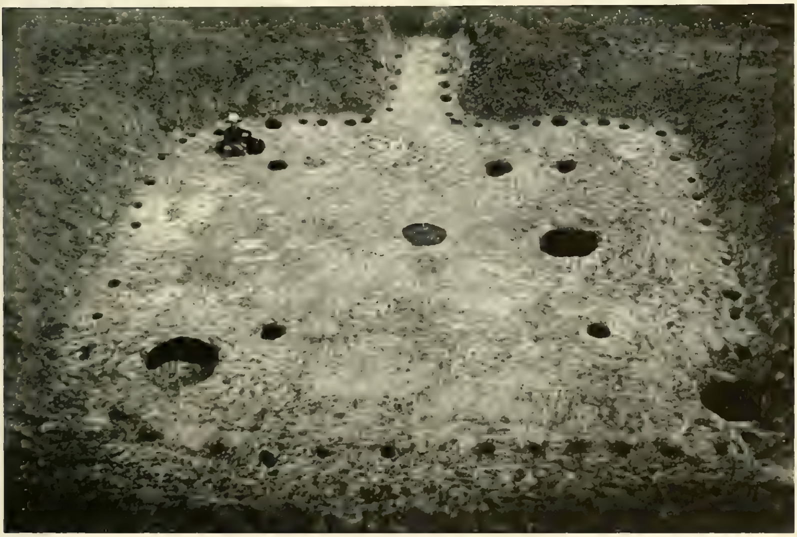


FIG. 110.—Prehistoric rectangular earthlodge floor at Griffing site on Wildcat Creek near Manhattan, Kans. Entrance passage to south.

Woodland in the Eastern United States. In Nebraska and Iowa it has been found stratigraphically below all other known local ceramic horizons. Directly associated with this cord-roughened pottery was a superior ware bearing decoration of the Hopewellian type (fig. 107, *A-D, F-H*), never before reported as far west as Kansas City. There was no trace of house remains, so the habitations must have been entirely of perishable materials. Refuse-filled storage pits were plentiful, and from them were taken many objects of chipped and ground stone, bone, and horn (fig. 108), as well as some native copper and hematite. Ground stone work included several grooved axes (fig. 108, *P*), one unfinished, a type whose makers in the central Plains have heretofore been unknown. The remains are unlike those left by any of the protohistoric and historic peoples in the region. Through courtesy of Transcontinental Western Air and Bureau of Air Commerce officials, the writer was afforded an unforgettable opportunity to make aerial observations of the site and its surroundings.

At the old river town of Doniphan, Kans., whose older residents still speak pridefully of a visit from Abraham Lincoln in 1859, we next investigated the site of an early Kansa Indian village. This is supposed to have been visited by Bourgmond in 1724 and was seen in ruins by Lewis and Clark in 1804. Several graves (fig. 109) and cache pits were opened, yielding both historical and native remains. Twenty miles north of Doniphan, at Fanning, another earlier but tribally unidentified village was examined. Some historical material was obtained here, but aboriginal remains of a type known to archeologists as Oneota were much more plentiful.

The latter part of the season was spent on the Kansas River near Manhattan, about 120 miles west of Kansas City. Here were found further traces of Hopewellian-like pottery. A few miles below the mouth of Blue River we excavated a circular house site in the old Kansa village visited and described by members of Major Long's exploring expedition in 1819. As expected at this late date, the native arts and crafts had largely been superseded by introduced European trade goods. No aboriginal pottery was found here. Two miles west of Manhattan a much older pre-contact village yielded a rectangular earthlodge floor (fig. 110) and lesser remains.

In summary, it was not possible to determine the distinguishing characteristics of early Kansa Indian culture. However, the season's work indicated a wealth of important and varied archeological remains in this portion of the Plains. For northeastern Kansas, the probable sequence of early peoples is emerging, at least in broad outline, but more extended investigations are needed before the details can be filled in.

ANCIENT SITES ON THE BANKS OF THE RAPPAHANNOCK IN VIRGINIA

By DAVID I. BUSHNELL, JR.
Collaborator in Anthropology, U. S. National Museum

During the spring of 1937 a great freshet swept down the valley of the Rappahannock from the foot of the Blue Ridge, where heavy rains had fallen for several days. The low grounds were inundated, and when the waters had receded it was discovered that many areas had been greatly altered, gullies had been formed, banks of sand had been deposited and, in some instances, the surface soil for a depth of a foot or more had been washed away, causing the heavier masses to settle and remain exposed. Traces of ancient camps and villages were thus revealed.

The valley of the Rappahannock below Fredericksburg is more open, the low grounds more extensive, and the river is wider than above the falls; nevertheless, the force of the great flood was felt far down the stream.

On May 9, when the ground was becoming dry, several places below the falls were again visited to see the effect of the flood and to endeavor to recover some of the material thought to have been deposited by the swirling waters. Fortunately, a site of much interest was encountered. It is on the right bank of the Rappahannock in Caroline County, Va., a mile or more below the mouth of Lamb Creek on the opposite side of the river and is shown in the aerial photograph reproduced in figure 111, to the right of the black arrow which points with the current. This is now a rich and fertile section of the valley, but visualize the same region as it was in 1608, when first visited by English colonists from Jamestown—a dense forest with small groups of mat- and bark-covered lodges dotting the river banks, trails traversing the wilderness, game and wildfowl to supply the wants and requirements of the native hunters armed with bows and arrows, and streams teeming with fish. However, the earlier settlement, traces of which were uncovered by the freshet, is thought to have been abandoned before the year 1608.

When the site was visited on May 9, the surface for a distance of a hundred yards or more from the river bank, and extending to the beginning of the wooded area, was sand and gravel, all vegetation had been swept away, and in places it was deeply gullied. Fragments of

pottery and objects of stone, some broken and others entire, were scattered over the surface, indicating the location of a native village which had been occupied centuries ago. Examples of the specimens collected at that time are shown in figure 112. Above are 15 objects made of white quartz, so plentiful in the valley. Projectile points, knives, and scrapers are included in the group. The four pieces to the left in the second row may have been mounted as knives and their simi-

FIG. 111.—Looking down the Rappahannock. Site of the ancient settlement to the right of the black arrow. (Photograph by U. S. Army Air Corps.)

larity in form and size is remarkable, but being made of quartz the condition and appearance of the surface does not aid in determining their relative age. Below are 9 pieces representing a variety of forms, all made of diabasic rock and with surfaces equally altered as a result of long exposure. At the bottom is a cylindrical pestle, with a short, shallow groove clearly shown in the photograph. Two forms of scrapers may be recognized. All specimens, quartz and diabase, are thought to be of approximately the same age. Some fragments of earthenware found on the site bear the impression of coiled basketry, and this is considered the oldest form of pottery occurring in the Rappahannock valley; other pieces are cord-marked and some are smooth, porous, and deeply pitted through the leaching away of the

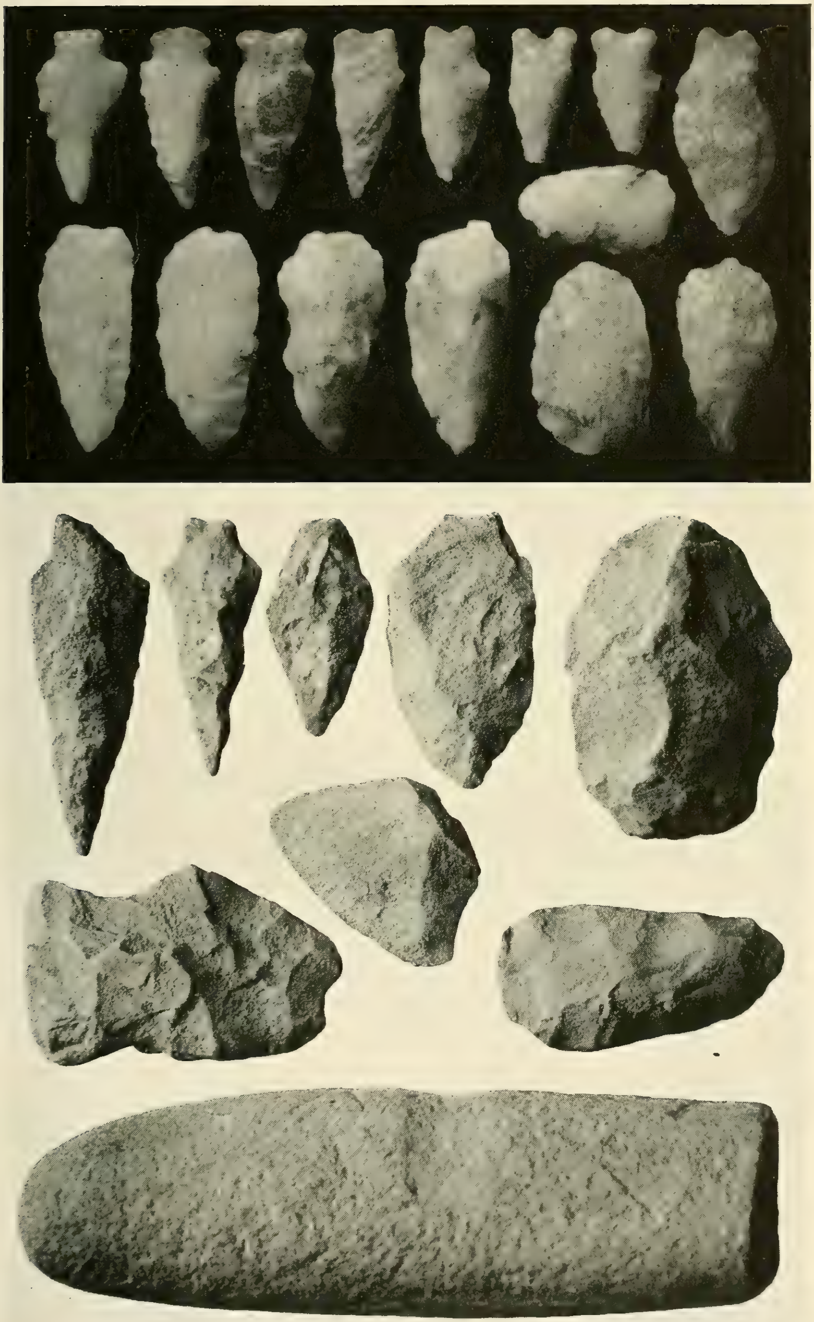


FIG. 112.—Specimens from the site of the ancient settlement. (½ natural size.)

crushed shell which had served as the tempering material. Bits of soapstone vessels were also found. The types and condition of the objects discovered suggest that this was a permanent village rather than a temporary camp, and the uniformity of the weathering makes it appear that all articles of stone were made and used about the same time.

Later in the year several sites farther up the river, which had likewise been exposed by the spring freshet, were visited and examined. The material discovered, much of which differs from that now figured, will be described and illustrated at another time.

Floods have been recorded ever since the country was settled by the English, when much of the heavy timber was cleared away and the ground was cultivated and leveled. The loosened earth was often inundated and gullied, as during the spring of 1937, and although the masses of refuse which had accumulated in and about the native villages during different periods of occupancy were once distinct and stratified or separated, all became intermingled by the force of the waters. This readily explains the variety of objects, made of various materials, often encountered on the same site. Such conditions prevailed not only on the Rappahannock but in the vicinity of other streams as well.

Some years ago a beautiful example of the eastern form of Folsom points was discovered near the left bank of the river a few miles below the site just described. Unfortunately, it was found on the surface, not beneath it, but this is not significant because, as explained above, the clearing and cultivating of the land enabled the periodic flood waters to change the contour of the land rapidly, and the Folsom point may therefore have once been well below the surface. The occurrence of the point in this region may be accepted as proof that man was here many centuries ago, although just how early he reached the country eastward from the mountains will be impossible to determine until more evidence is available.

During the year 1937, as for several preceding years, a superficial examination was made of many sites both above and below the falls of the Rappahannock. The results were interesting and satisfactory, and have led to the belief that an intensive investigation, including the excavation of certain areas, would prove of exceptional value and shed light on the manners and ways of life, and possibly reveal the identity, of the early inhabitants of the valley.

PICKING UP DE SOTO'S TRAIL

By JOHN R. SWANTON
Ethnologist, Bureau of American Ethnology

Between 1939 and 1943 will occur the 400th anniversary of Hernando De Soto's expedition across America to the Mississippi. As chairman of the U. S. De Soto Expedition Commission, appointed by Congress to recommend an appropriate celebration of this event, I engaged in two field trips, the first, May 16 to June 4, and the second October 8 to November 2. At Aberdeen, Miss., near which point it is believed that De Soto crossed the Tombigbee River, I had the pleasure of being the guest of Dr. W. A. Evans, for more than 40 years a leading physician of Chicago, who has now retired to his boyhood home at Aberdeen. Dr. Evans took or sent me in his own car to all points of interest along the Tombigbee from Columbus as far as and beyond the site of Cotton Gin Port near the junction of the main river and Town Creek, the possibilities of each of the crossings being examined in turn, as well as the roads which might have been taken by De Soto between the river and Pontotoc Ridge. Assuming that the Chickasaw town was then on the ridge, it is concluded that, while the crossing may have been made as high up as Cotton Gin Port, the most probable location appears to be in the neighborhood of Aberdeen. A visit was made to the site of the old fort occupied by Bienville in 1736 during his disastrous Chickasaw campaign. Collections of pottery made in this section were examined wherever any such were found, and samples of some of them were obtained.

On the 22nd Dr. Evans took me to Oxford, and I made that the center for a number of excursions undertaken for the purpose of locating the Alibamo Province visited by De Soto in 1541, and studying the probable location of the trail which the Spaniards followed between the old Chickasaw country and the Mississippi (fig. 113). During part of this work I was accompanied by Prof. Calvin S. Brown, author of the standard work on the "Archeology of Mississippi." On one occasion we extended our trip to Clarksdale, where we were met and guided through that section by Charles W. Clark, who has long been interested in the subject of the investigations (fig. 114). Small collections of pottery were made at several places and much interesting historical information collected. Before returning to Washington I visited Tupelo and was taken over the historic Chickasaw

FIG. 113.—Indian Mound on the bank of Otukalofa Creek, north of Banner, Miss., and near the trail probably followed by De Soto on his way from the Chickasaw country to the Mississippi River.

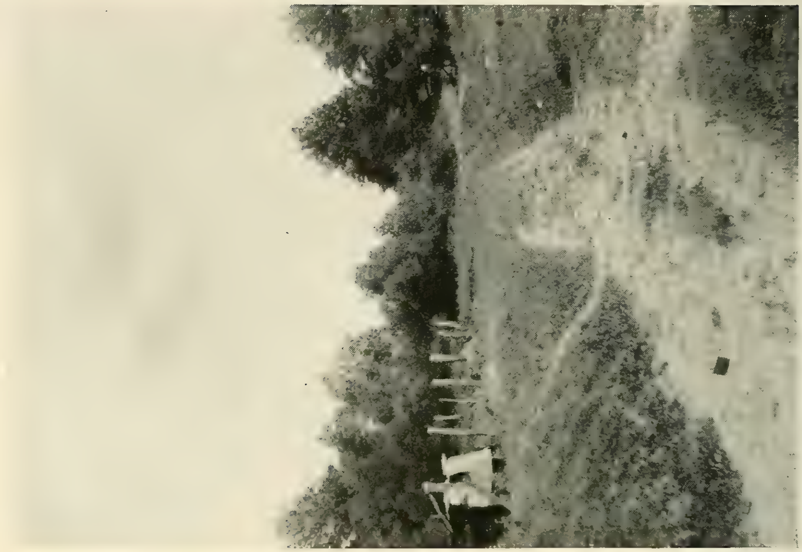


FIG. 114.—On the line of "Charley's Trace," where it crosses Hopson's Bayou, Miss.

FIG. 115.—Site of old Indian salt works on Salt Creek, Clarke Co., Ala.

FIG. 116.—View up Tennessee River from Battery Hill, Bridgeport, Ala., looking across Long Island. An old ford, possibly used by De Soto, is just below at the right.

town sites by Moreau B. Chambers of the Mississippi State Department of Archives and History, who was then engaged in attempting to locate the site of the old Bienville battlefield. I also had an opportunity to visit that section of the Tombigbee south of Tupelo.

The second expedition was directed primarily to the investigation of a site in Clarke County, Ala., on the banks of Choctaw Lake near the Alabama River, which it was thought might prove to be the long-looked-for location of the town of Mabila at which De Soto's most famous battle with the Indians took place. James Y. Brame, Jr., of Montgomery, Ala., the discoverer of this site, one of the foremost students of the De Soto narratives and the De Soto route, organized and promoted this investigation and obtained for its purposes access to the land and the use of a camp maintained by the Choctaw Hunting and Fishing Club at Choctaw Bluff. The site is known locally as Lower James Hammock and its position agrees well with what the documents of the De Soto expedition would lead us to expect. Numbers of test holes on this site failed, however, to show evidence that it had been surrounded by a stockade or traces of European materials or of skeletons, and while there is still a possibility that this is the site in question, it remains unproven. The potsherds collected here show certain interesting features, particularly in the employment of the edge of a corrugated shell in decorative designs and indications that the Indians living here made pots with long legs comparable in length to some used in Costa Rica, though there is no cultural relation whatever between them. After work was suspended at this site, investigations were extended to other parts of the county, but with the exception of a small site near Gainestown previously located by Mr. Brame, and the old salt works along Salt Creek (fig. 115), no Indian remains of consequence were found in the sections visited.

After leaving Clarke County, I went to Tuscaloosa, and from there David L. De Jarnette took me to Scottsboro, from which point as a center I was enabled to examine the middle course of the Tennessee River between Guntersville and the Tennessee State line, the object being to determine the probable route pursued by De Soto's army in descending this river in the summer of 1540 (fig. 116). It seems evident that they crossed and recrossed more times than have been supposed.

THE LINDENMEIER SITE IN NORTHERN COLORADO CONTRIBUTES ADDITIONAL DATA ON THE FOLSOM COMPLEX

By FRANK H. H. ROBERTS, JR.
Archeologist, Bureau of American Ethnology.

Investigations in a little-known phase of American archeology were continued during the summer of 1937 at the Lindenmeier Site in northern Colorado. It is at this location that Folsom man, one of the earliest known inhabitants of the New World, camped and left numerous examples of the weapons and tools that he manufactured and used in his occupation of killing big game. Excavations made in previous field seasons contributed much information on the material culture of the people and threw some light on their mode of life, but they produced no skeletal remains to show what manner of men they were. The 1937 work added valuable data on various phases of the problem, although it failed to locate any of the elusive individuals or to find even one human bone.

When the writer and members of the Bureau of American Ethnology-Smithsonian expedition returned to the Lindenmeier ranch in June, excavations were resumed at the place where they terminated at the end of the preceding season. During the course of the summer an area covering some 2,800 square feet was uncovered and numerous traces of occupation were found (fig. 117). The level where the remains occur follows an old hillside and its depth below the present surface ranges from 4 feet, where work began, to 6 feet 3 inches, the point reached when the season closed.

Specimens are found either at the bottom of an old soil zone or in a thin layer of earth, only slightly stained with humus, just below it. The underlying stratum over the entire area is a hard tufaceous clay dating from the Oligocene. In some places the dark soil stratum rests on this clay and the artifacts are along the contact. Where the thin stained earth layer intervenes, the objects are scattered through it. The importance of this occurrence is that it demonstrates the presence of the people in the region prior to the developments leading to the formation of the heavy soil zone, as well as during its initial stages. The thin layer was formed by the decay of the surface of the tufaceous layer, the deposition of some wind-borne material, and some decaying vegetal matter. Sections where it is absent con-

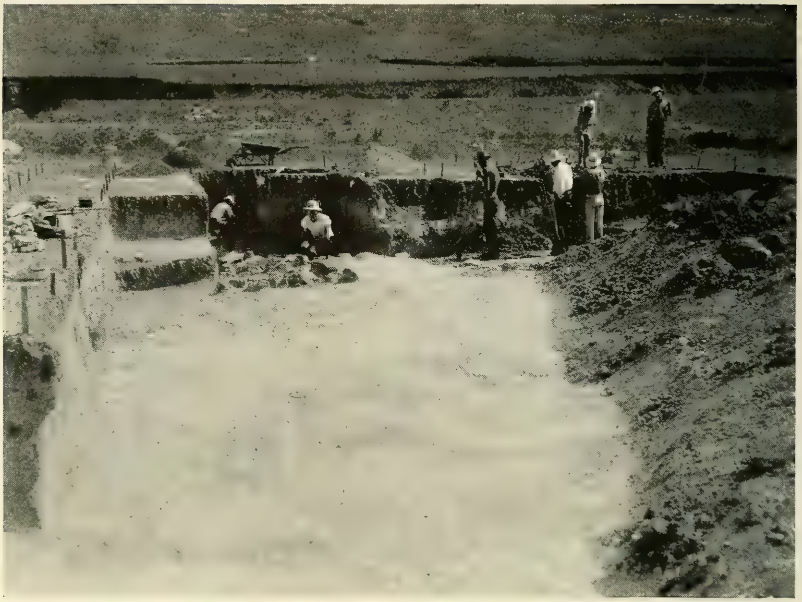


Fig. 117.—General view of portion of area being excavated.

Fig. 118.—Boulders used as anvils in left foreground of picture.

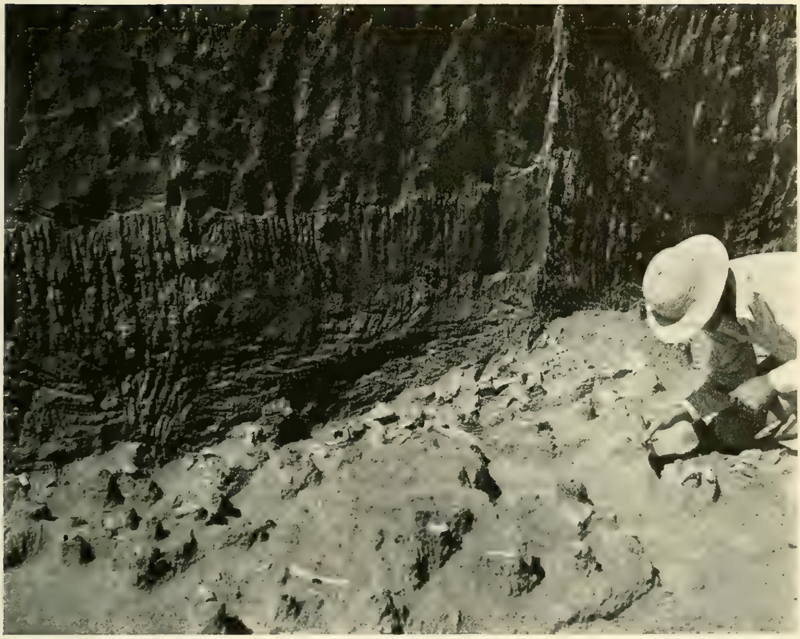


FIG. 119.—Workman uncovering cut and split animal bones.

FIG. 120.—Stone implements and bone fragments in situ.

stitute high spots on the surface of the tufaceous layer that were exposed to wind and water action. The latter either prevented the formation of the thin layer or carried it away and permitted the heavy soil zone to develop on top of the clay substratum. The thicker, dark layer was produced by heavy vegetation, rank grasses, during an interval when there was considerably more moisture and more propitious growing conditions. This factor ties in with geologic studies of the site and surrounding area and is of significance from the standpoint of the age of the site.

A number of boulders were lying on what was once the old hillside (fig. 118). These stones were in the same positions that they had occupied when that level was the inhabited surface. Several showed that they were used for anvils. Bones, to be cracked and split for marrow, and stone nodules, sources of material from which to make tools, were placed on these boulders and struck with hand-held hammer stones. Innumerable splinters and small fragments of bones were in the dirt around some of them, while flakes and chips of chert, chalcedony, jasper, and other materials favored for implements lay alongside others. The status of the objects definitely indicated that they were just as left by the one-time dwellers at the site, that they were not washed there, and that this actually was a portion of the former camp.

Other parts of the excavated area yielded quantities of cut and split animal bones (fig. 119) associated with stone implements (fig. 120) and other evidences of human activity. The implements consist of typically fluted projectile points, scrapers of various kinds, knives, drills, and flakes with minute points that probably were used to scratch designs on bone and stone. Many of these artifacts are similar to those found in previous years, but a number represent new types. Several bone fragments bearing portions of incised decorations were also obtained.

Dr. Kirk Bryan and Louis L. Ray, of the Division of Geology, Harvard University, continued their geologic investigation of the site and neighboring regions and by the close of the season were able to formulate conclusions on the age of the deposits. The evidence indicates that the cultural layer was made long after the climax of the Wisconsin period and within the Late Glacial. Hence, it may be said that Folsom man lived in the region several thousands of years ago, while glaciers still lingered in the nearby mountains and the climate was colder and wetter than at present. The latter feature probably accounts, in part, for the heavy soil zone at the site.

STUDIES AMONG THE MONTAGNAIS-NASKAPI INDIANS OF THE NORTHERN SHORE OF THE ST. LAWRENCE RIVER

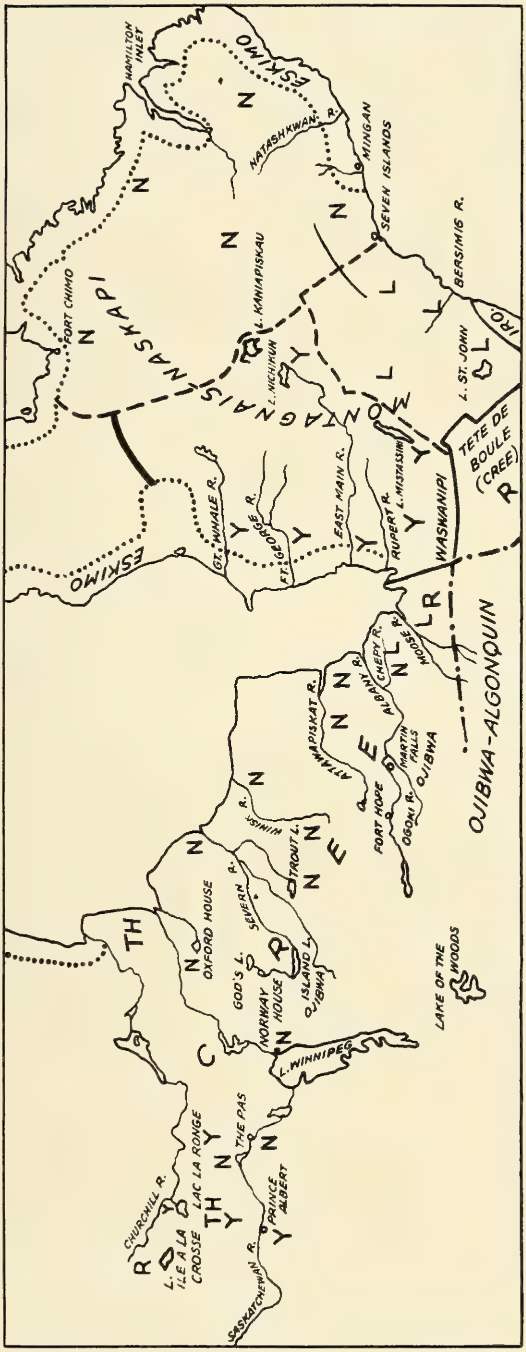
By TRUMAN MICHELSON
Ethnologist, Bureau of American Ethnology

Through a generous grant-in-aid made by the American Council of Learned Societies, the writer was enabled during the summer of 1937 to undertake field-work among the Montagnais-Naskapi Indians in Canada. Early in July he went to Quebec and from there embarked on the steamship *Sable I* of the Clark Steamship Company for Natashquan, where he stayed a little over 2 weeks. He spent another 2 weeks at Seven Islands, and then went to Bersimis, where he spent a few days. Owing to the migratory habits of the Indians, however, he was able to get data on the Indians of a number of other places in this region, including Mingan, Moisie, St. Margaret's River, Godbout, Shelterbay, and Sheldrake. He was also able to check his previous information on the Davis Inlet Indians of the Labrador Coast, and by good fortune came in contact with an Indian of a band from the northeast corner of Lake Kaniapiskau—a band barely known to the scientific world.

The principal object was to complete a linguistic map showing the distribution and interrelations of the Cree and Montagnais-Naskapi dialects, upon which the writer has worked for some years. The main results of the expedition are that the extreme eastern dialects on the north shore of the St. Lawrence River are rather sharply defined, and the most western ones clearly "tie up with" the dialect of Lake St. John, whereas the intervening dialects show a variety of mixtures; the dialect at the northeastern end of Lake Kaniapiskau is obviously closely related to the dialect of Rupert's House on James Bay. The technical proofs of these assertions will be given in professional journals. The accompanying map is based not only on two seasons of field-work among the Indians of the area adjacent to James and Hudson's Bays financed by the American Council of Learned Societies, but also on data furnished by the post-managers of the Hudson's Bay Company of Cumberland House, Oxford House, and Norway House, as well as by some missionaries, and on certain documentary sources of information. The letters *l, th, n, y, r,* show the treatment of original *l*. These transformations have taken place inde-

Fig. 121.—Indians at Natashquan.

Fig. 122.—Bersimis. Leaving for the north.



DISTRIBUTION AND INTERRELATIONS OF THE CREE AND MONTAGNAIS-NASKAPI DIALECTS. BY TRUMAN MICHELSON. DEC., 1937.

FIG. 123.

pendently a number of times, and those in the Cree dialects are independent of those in the Montagnais-Naskapi ones.

It should be noted that after three centuries the Indians of the northern shore of the St. Lawrence River still have some of the identical stories which can be read in the Jesuit Relations. It might also be remarked that their catholicism is superficial, shamanism is found everywhere except at the posts, and at one post the writer saw one of the large conjuring drums. In aboriginal belief, there is a "boss of the caribou" and a "boss of the fishes"; inside the conjuring lodge ("the shaking lodge") is an "interpreter" (Mistapeu and variations); the all-high god is "he who bosses it" (Kátependahk and variations). An interesting observation was that at the northeastern corner of Lake Kaniapiskau a man may marry his paternal aunt's daughter, but that is the only girl cousin he may marry. It may be remarked that the Montagnais-Naskapi of the Labrador Peninsula represent the original culture of Algonquian least modified by contact with other Indians. Also it should be observed that there are marked individualities among the Montagnais-Naskapi just as there are with us.

A tragic element in the lives of the kindly French-Canadians who inhabit the north shore of the St. Lawrence is the prevalent poverty. They depend entirely for their livelihood on hunting and fishing, but furs do not bring what they used to, and the salmon is not as common as formerly. Moreover, a number starve to death in the woods every winter, as do also many Indians.

The writer was fortunate in meeting on his journeys a number of Canadian scientists, including Prof. G. Préfontaine, of the department of biology at the University of Montreal, who was tagging salmon; Dr. H. F. Lewis, of the National Parks of Canada; and T. W. Wylie, of Ottawa. To these he extends his best thanks for their welcome aid, as he does also to the Doctors La Vallee, of Seven Islands and Bersimis, the officials in charge of the Indians at these localities.

SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1938

(PUBLICATION 3525)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
1939

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

PREFACE

The stated function of the Smithsonian Institution, "the increase and diffusion of knowledge," is carried out mainly by research, scientific exploration, and publication. Several of the branches of science prominent in the activities of the Institution depend to a large extent on field exploration for specimens and data. The present pamphlet describes briefly the results of the 1938 expeditions in the interests of geology, biology, anthropology, and astrophysics. The articles are written, and the photographs taken, largely by the field explorers themselves.

This year's pamphlet has as a unique feature a foreword to one of the articles written by the President of the United States, Franklin D. Roosevelt. The Institution is grateful to him not only for making it possible for it to be represented on the expedition described, but also for the interest in the Smithsonian's scientific work which he expresses.

W. P. True, *Editor.*

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Fig. 1.—The U.S.S. *Houston,* Chatham Bay, Cocos Island. August 1-3, 1938.

THE PRESIDENTIAL CRUISE OF 1938

FOREWORD

I gladly avail myself of this opportunity to say publicly that, in addition to the personal pleasure his presence afforded those of us who made the cruise aboard the U.S.S. *Houston* last summer, it was a source of great satisfaction to have Dr. Waldo L. Schmitt with us in the role of scientist representing the Smithsonian Institution. I am advised that the collections he made, with the assistance of the officers and enlisted men of the *Houston,* have contributed greatly to the treasure of exhibits the Smithsonian already has gained possession of through previous explorations by its scientists in that part of the world we visited.

I believe our experience points the way whereby the Smithsonian Institution, in the future, at practically no cost whatever to itself, will be able to extend its research work into other parts of the world and make it possible for its scientists still further to enrich our knowledge of natural history. I have no doubt but that the Smithsonian would have gained much worthwhile information had any one or a number of its scientists accompanied the Naval Expedition which went last year to the Enderbury and Canton Islands. That Expedition was exclusively astronomical in character. Its members went to observe the eclipse that took place on June 8. They were not particularly concerned about natural history nor in learning of the other interesting phases of life as it exists on the Islands themselves or in the waters thereabout.

If the Smithsonian Institution, in the future, would care to be represented in such expeditions as the United States Navy and other government services send out from time to time, I shall be glad to help make the necessary arrangements.

We cannot know too much about the natural history of this world of ours. We should not be satisfied merely with what we do know.

FRANKLIN D. ROOSEVELT.

THE WHITE HOUSE
Washington
December 20, 1938

THE PRESIDENTIAL CRUISE OF 1938

By WALDO L. SCHMITT
Curator, Division of Marine Invertebrates,
U. S. National Museum

When the President invited the Smithsonian Institution to participate in his recent cruise to the Galapagos Islands, I was pleased beyond words that I was designated Naturalist to the expedition. All manner of collecting was undertaken: fishing, bird hunting and botanizing, dredging, tidepool and shore collecting—indeed all kinds of endeavor that might yield something of interest to the Institution and our National Collections. The ichthyological collection, which perhaps took first place in the President's interest, is one of the most important ever to have come to the National Museum from that section of the Pacific.

In looking over the material brought back, one cannot help being imbued with an enthusiastic appreciation of the President as a man of broad biological interests and a generous patron of science. Throughout the cruise he took an active part and a live interest in all our collecting.

The success of any expedition depends almost wholly upon the adequacy of its equipment and personnel. Expeditions to otherwise inaccessible places are using ever larger airplanes, and so, too, the use of correspondingly larger ships has proved to be of untold value in marine investigations. This, I know, is quite the reverse of what an uninitiated investigator might be led to believe, but the use of a large battle cruiser such as the U.S.S. *Houston* proved an unqualified asset and a blessing every day of the trip. Having this ship as our base of operations made it possible to accomplish as much as we did in a scant 24 days at sea.

The *Houston* is a full 600 feet in length. Her full complement totals over 700 men and officers. On this particular cruise, however, the crew numbered nearer 600. Thus, at all times there was ample assistance at hand for whatever undertaking the day might bring forth.

The ship has a top speed of 32 knots, which is something like 40 miles an hour. However, at no time did she find it necessary to go above 26 knots, about 30 miles an hour. The *Houston*, moreover,

FIG. 2.—Clipperton Island landing. The island is an almost barren sand and coral atoll, about 600 miles off the coast of Mexico.

FIG. 3.—Narborough Island from Tagus Cove, Galapagos. Characteristic of most of the islands of the archipelago, it is composed of a central volcano whose outpourings of lava have built up the island through the ages.

FIG. 4.—Leaping porpoise, Hood Island, Galapagos. (Photograph by R. B. Thompson.)

FIG. 5.—Landing party at Elizabeth Bay, Albemarle Island, Galapagos. Three members of the crew have a sea turtle which they have just captured. This launch was put at Dr. Schmitt's disposal for the duration of the expedition, both for dredging and shore collecting. (Photograph by R. B. Thompson.)

has fully equipped shops equal to any emergency: machine, carpenter, and electrical shops, sail maker, airplane mechanics, print shop, barber shop, and, of course, superlative medical service and hospital, with complete dental laboratory, clinic, and staff. Built to serve as fleet flagship, this cruiser had ample accommodations for a number of guests, as well as convenient laboratory and storage facilities for my work.

We left San Diego July 16, and the following afternoon found us at anchor off Cedros Island, Lower California. In a comparatively short time 37 fish were caught by the fishing parties, besides some 200 others which were taken over the side by members of the crew using hand lines. Among these was numbered a 120-pound black sea bass or jew fish caught on a light 20-pound test line. Although groupers and sea bass of several species were plentiful, California yellowtails formed an important part of the day's catch in the fish-boats.

The next three days in succession were spent at Magdalena Bay, July 18; off Punta Gorda, Cape San Lucas, July 19; and Socorro Island, July 20.

At Magdalena Bay the only white sea bass, *Cynoscion nobilis,* of the cruise was captured. Here the dredging was very rich. On the sandy, weedy bottom of the bay, inside the entrance to the northward, in 10 to 15 fathoms, an almost incredible number of amphipod crustaceans were discovered. The water in the buckets used to transport the dredged material to the laboratory aboard the *Houston* became covered with a thick film or "scum" of these small shrimplike organisms. In the portion of the bay worked over they must have been literally as numerous as the grains of sand on the bottom. I have never seen so many amphipods in one place before. Our Museum amphipod specialist, Clarence R. Shoemaker, was moved to make the same remark when he was presented with more than a solidly packed quart of them. It was an amazing sight.

The capture of a large gulf grouper, *Mycteroperca jordani,* at Cape San Lucas extends the range of this species southward on the west side of the Gulf of California below Cerralvo Island, south of which it had not been taken before on this side of the Gulf. This particular specimen, by the way, is the first of the species to find its way into the collections of the National Museum.

At about 11 o'clock at night one of the engineer officers called me to the engine room to see a lot of bright red shrimp they had discovered in the suction side of one of the condensers opened for minor repairs. It was a galatheid shrimp very common in Lower California

waters, at least at certain seasons. At times they occur in such countless numbers they color the water red for great distances. Huge windrows of the dead shells of these animals have been observed in the past as a conspicuous red streak along the shore line. Crustaceans of this type form an important whale food and without doubt this species played an important part in the former abundance of whales in the Lower Californian and Mexican waters. A large black sea bass taken in Magdalena Bay during the day regurgitated several of these galatheids when hauled into the boat.

At Socorro Island, July 20, some of the best fishing of the cruise was experienced. Leopard groupers, spotted cabrillas, California yellowtails, and also several blue crevallys were taken. The President landed the scientific prize of the day, a blue crevally, *Caranx stellatus*, establishing a record weight for the species—38 pounds. From along shore in Braithwaite Bay, a small mullet, *Mugil setosus*, was obtained; also the first of its kind that the National Museum ever received.

On July 21, an eventful day and one of the high lights of the cruise, we landed on Clipperton Island, the only true coral atoll in eastern Pacific waters. Dr. Wetmore had long been anxious to obtain a study series of the birds frequenting this isolated and seldom-visited coral island. Thirty-two birds were obtained, as well as a fair sample of its marine fauna. At least one new species of crab was discovered here. Dr. William Randolph Taylor, of the University of Michigan, who has prepared for publication a report on the algae taken, writes: "The Clipperton Island collections are unique, for landing on this isolated atoll is especially difficult." He states further that he found the jars of mixed algae from the lagoon very surprising, inasmuch as he had assumed that the water was salt by seepage or other admixture from the sea. The plants he found indicated, "on the contrary, that it is at least nearly fresh, at any rate near the surface and in the shallows, though probably heavily polluted with nitrogenous matter from the bird colonies. The bulk of the material was of Myxophyceae, which is appropriate under such conditions, and apparently great masses of *Lyngbya versicolor* must have been present at least near the shore. This is not a definitely marine species. With it were other Myxophyceae of cosmopolitan habits. In sparing amounts an undeterminable Chara appeared. Finally, four desmids were found in considerable numbers." One of these Dr. Taylor is describing as new.

Unfortunately, we did not obtain a sample of the lagoon water, as had been planned, for, although the landing was not particularly hazardous at the time of our visit, it was nonetheless difficult and had

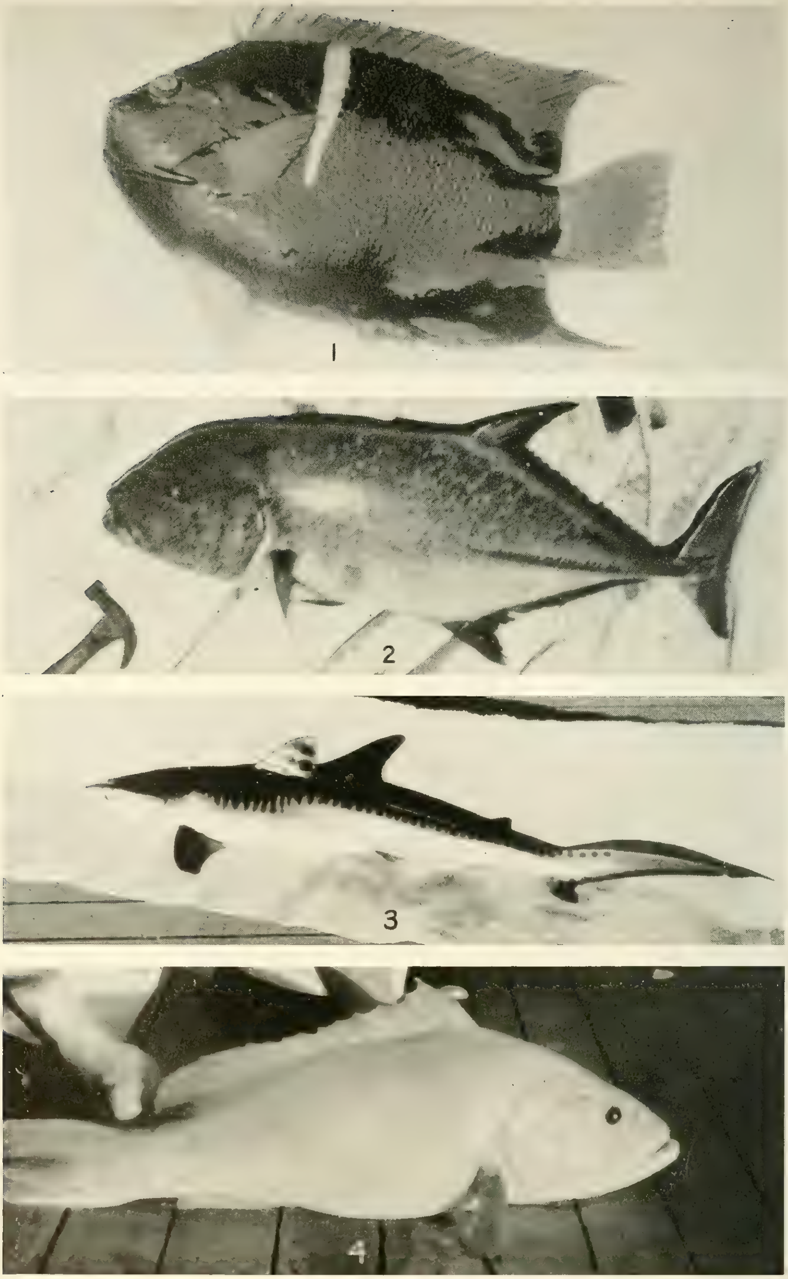

FIG. 6.—1. Pacific "rock beauty," *Holacanthus passer,* Gardner Bay, Hood Island, Galapagos, 12 inches in length. (Photograph by R. B. Thompson.)

2. "Blue crevally," *Caranx stellatus.* This species was taken at Cape San Lucas, Socorro Island, and Cocos Island. At Socorro, the President caught a 38-pound one, the heaviest on record. (Photograph by F. B. Adams.)

3. Young tiger shark, *Galeocerdo arcticus,* a 60-pound specimen taken at Clipperton, still showing the characteristic striping that gives this species its name. (Photograph by R. B. Thompson.)

4. "Golden grouper," the beautiful reddish golden-yellow form of the common Colorado grouper of the Galapagos Islands, *Mycteroperca olfax,* caught off Tagus Cove. (Photograph by R. B. Thompson.)

FIG. 7.—Land iguana on the defensive, South Seymour Island, Galapagos. (Photograph by R. B. Thompson.)

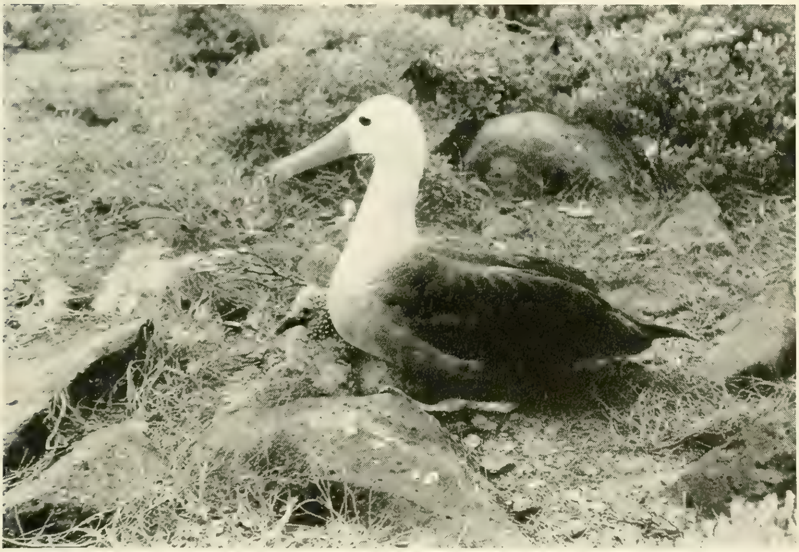

FIG. 8.—Galapagos albatross with young at the rookery on Hood Island, Galapagos, July 28. (Photograph by R. B. Thompson.)

to be made partly by swimming through the surf. Our getting ashore on Clipperton is just another tribute to the efficiency of the Navy and a further instance of the value of their cooperation in scientific exploration. Landing in heavy surf is a part of the Navy's routine training, and so they took the Clipperton landing in their stride, as it were.

There were so many sharks at Clipperton that they utterly ruined the fishing. Not only did they destroy the few fish that were hooked, but they usually destroyed the tackle as soon as it was put into the water. Closer in toward shore the President observed a considerable number of blue trigger fish schooling about at the surface and, desirous of knowing more about them and obtaining a few specimens of them for the Museum, he tried baiting a trout hook with a tiny strip of fish skin. It was just the thing, for three of them were caught in short order. These beautifully colored trigger fish, *Melichthys radula,* occur also in the East Indies and are found in Hawaii and at Socorro and Clarion Island, as well. The President, who at all times was as much interested in the bottom and reef species as in the game fish, got another of these blue trigger fish at Cocos Island.

Eight days, July 24-31, were devoted to our Galapagos investigations. In these scientifically famous islands were made some of the best hauls of fish of the entire cruise. A number of rarities such as the gray thread-fin bass, *Cratinus agassizii,* and the southern barracuda, *Sphyraena idiastes,* were taken on several occasions. The former looked like a good pan fish. As no one seemed to have any information on the subject and nothing could be found in any publications available on board, the President had one prepared for his mess. He said it was very good eating. The heaviest yellow-fin tuna taken weighed 56 pounds. Wahoo were plentiful off Hood Island and gave those of the party who tangled with them "a run for their money." The largest weighed 54 pounds. Three were brought back to the Museum for study, as the Institution heretofore had only a mounted specimen of this large game fish.

Together with the wahoo, five species of fish never before represented in the study collections of the Museum were obtained in the Galapagos. The other four species were the Pacific amberjack, *Seriola colburni,* of which the heaviest weighed 28 pounds; the round-herring, *Etrumeus micropus;* a pilot fish, *Doydixodon freminvillei;* and a demoiselle, *Nexilosus albemarleus.* The Pacific amberjacks constitute the first record of this species from the Galapagos Islands.

We visited the famed albatross colony on Hood Island, and found a number of birds at this late date, July 28, still incubating eggs and

FIG. 9.—Frigate birds attracted by the sailfish bait off Cocos Island. The birds tried to fly away with the bait on several occasions.

FIG. 10.—Flamingo walk—not a new dance, but a striking almost rhythmic walk affected by these birds at times. Salt lagoon at James Bay, James Island, Galapagos.

others with fledgling young. Two days before, we had noted two pairs of flightless cormorants on Albemarle, one pair with eggs under one of the birds, the other pair attending two half-grown young. It is believed that these observations extend the known egg dates for both species of birds.

On a number of occasions some very interesting animal life was obtained from the anchor chain. For instance, when the anchor was hoisted at Tagus Cove, a number of specimens of sea urchins were found attached to the chain. They belonged to a genus new to the Galapagos and, moreover, represented a new species.

Two and a half days were given over to the reputed "treasure island" of the Pacific, Cocos Island. It was indeed a treasure house of sailfish, for 16 were obtained in the course of the brief stay there. The largest was 10 feet 2 inches long and weighed upward of 130 pounds. The President captured a record rainbow runner, *Elagatis bipinnulatus,* a 20-pound specimen of a species not heretofore known to have exceeded 12 pounds. He also had a most interesting experience—the landing of a 9½-foot, 100-pound sailfish in a knotted loop of his line. The "beak" of the fish became entangled in the line while he was playing a still larger individual that had been hooked a moment earlier. Although the hooked fish got away, he managed to bring the snared one to gaff. Those who have seen the beak of the fish, which the President has saved with the knot in place, believe that this is the first time a good-sized sailfish or perhaps any sailfish has been landed in this manner. The top fish for weight taken by any member of the President's party was a 230-pound tiger shark, *Galeocerdo arcticus,* that he himself hooked while circumnavigating Cocos Island. It took him a good 1½ hours to land it. Off Chatham Bay a party from our convoy, the U.S.S. *McDougal,* harpooned a giant ray, *Manta birostris,* which should be mentioned here because it is one of the few specimens for which one is able to record the actual weight. It tipped a heavy-duty boat scales at 1,645 pounds, and measured 15 feet wide and 9 feet long, exclusive of its 4-foot tail.

With the aid of a detachment of officers and men from the *Houston* I obtained comprehensive botanical material of an undescribed species of palm, and some rare tree ferns of which several species are known from this still incompletely explored island.

The next leg of our journey, Cocos to Balboa, was uneventful. No scientific collecting was undertaken in the Canal Zone, August 4-5.

Collecting was resumed at Old Providence Island in the Caribbean on August 6. Though lying abreast the Atlantic coast of the Republic

FIG. 11.—Mr. Frederick Adams with his Cocos Island sailfish, 9 feet 7 inches long, 120 pounds. The large tiger shark on the deck weighed about 230 pounds. It was brought in by the President after a tug-of-war of an hour and 36 minutes. It was the heaviest fish of the cruise caught with rod and reel.

of Nicaragua, this island is a part of the Republic of Colombia. There was no sport fishing at Old Providence. Game fish were scarce or absent, a few mackerel and two young barracuda constituting the catch by the fishing parties. On the other hand, the shore and reef collecting and dredging were very productive. Two new species of goboid fish were caught in a tidepool, also a small rockfish new to the Museum collections, as well as a new form of marine plant.

Our arrival at Pensacola on August 9, the twenty-fourth day, 5,888 miles out from San Diego, marked the conclusion of a most successful cruise. Over and above a host of other scientific material—geological, botanical, and zoological—83 different species of fish were caught by one means or another. Still other species were seen, but for want of specimens could not be identified, such as the large green parrot fish at Clipperton. About 250 individual fish, representing about 60 different species, were brought back to the Museum for study and permanent preservation in the National Collections.

The larger game fish are most inadequately represented in ichthyological collections throughout the world, not so much for want of facilities for storing them, as because of the difficulties attendant upon their preservation at the time of capture and their transport to their final resting place, which in the past necessitated large and often unwieldy tanks and almost unmanageable quantities of preserving fluid. Aboard the *Houston,* however, it was a relatively simple task to place the specimens desired by the Museum in the large cold storage freezers of the ship, and then, on arrival at port, to pack them with dry ice in wooden packing cases, suitably insulated with corrugated paper, for safe shipment to Washington. The fish were unpacked there still hard frozen. When thawed out in tanks of tap water, they returned to practically the identical fresh condition in which they had been placed in cold storage. Many of the fish still retained much of their original coloration, having apparently undergone little or no change from the time they were brought aboard ship. This is but one of many instances in which a large ship with ample facilities of all kinds can render science inestimable service.

To the President, as Commander-in-Chief of the Navy and of this expedition, and to Captain Barker and the officers and crew of the U.S.S. *Houston,* the Smithsonian Institution is indebted for a wealth of valuable material, including some 30 forms new to science which will be described in technical publications of the Institution.

A NEW OBSERVATORY, AND SOME MOUNT WILSON OBSERVATIONS

By C. G. ABBOT

Secretary, Smithsonian Institution

Thirteen years ago the National Geographic Society sent me to find a suitable place in the Old World to observe the variation of the sun. For the sun had been proved to be a slightly variable star, and it was thought its changes might be the main element in weather control. After investigating sites on lonely desert mountains in Algeria and Baluchistan, I fixed on Mount Brukkaros in South West Africa, within a Hottentot reservation. With a grant from the National Geographic Society, an outfit of special apparatus was assembled, and a tunnel observatory and a dwelling house were constructed on the western rim of that craterlike desolate mountain.

For 5 years the sun was observed there on every possible day. But though the sun nearly always shines on Mount Brukkaros and rain hardly ever falls, we were disappointed to find that high winds carry the fine sands of the desert high over the summit, making the atmosphere hazy and nonuniform, and involving too great a handicap in measuring solar variation.

Then A. F. Moore sought to select a better station than Mount Brukkaros by measuring conditions on a number of African mountains, beginning on the Cape Verde Islands and going the rounds till he arrived at Mount St. Katherine near Mount Sinai, in Egypt. Here after over a hundred days of preliminary trials, it was decided that a favorable site had been found. The equipment from Mount Brukkaros was installed on Mount St. Katherine, and complete observations of solar radiation were made there from 1933 to 1937. The station proved excellent from a meteorological point of view.

However, with a European war gravely threatening, and because of excessive cost of upkeep due to the inaccessibility of Mount St. Katherine, and a depressing and persistent intestinal disorder which attacked almost all members of the staff, it was found advisable to abandon the station in December 1937.

Hoping to put our observing of solar variation on a more easily maintained basis, and to fill in good observations in the interval December to February when both of our other stations, in California and in Chile, usually lose many days, I decided to locate a new station in southwestern New Mexico. This region seems to partake to a

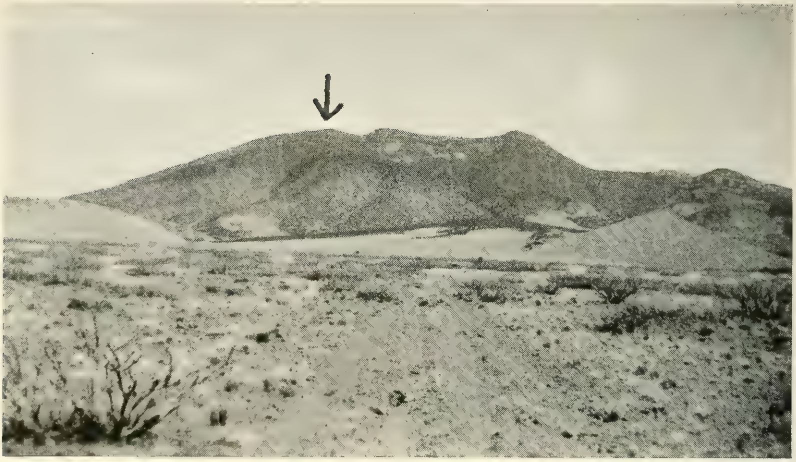

FIG. 12.—Observatory site at Burro Mountain, N. Mex.

FIG. 13.—Dwelling house of Mr. A. F. Moore, chief of the staff at Burro Mountain solar observing station.

FIG. 14.—Excavating for the "tunnel."

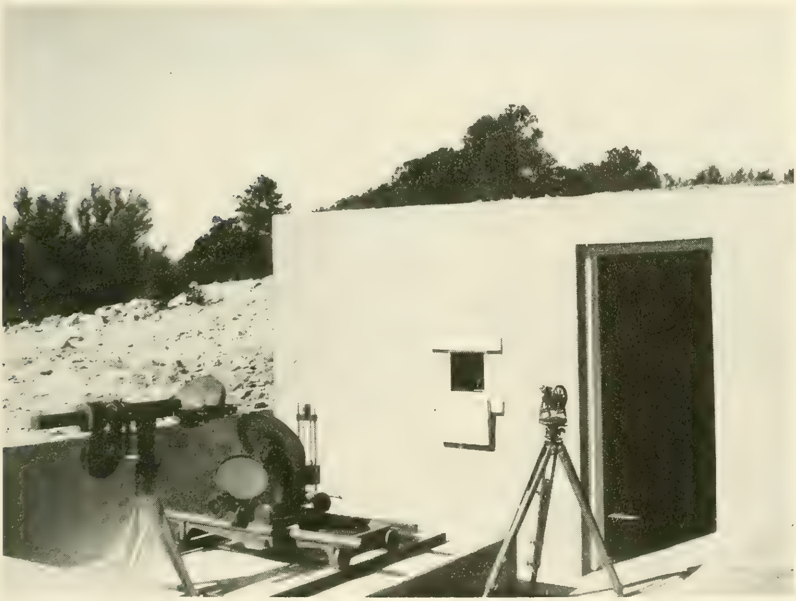

FIG. 15.—Instrument tunnel at Burro Mountain solar observing station.

considerable degree of the meteorology of Old Mexico, where there are various sections which receive almost no precipitation except in the months July to September.

Accordingly, A. F. Moore made a reconnaissance of various mountains in southwestern New Mexico. Some proved too difficultly accessible, some deficient as to water supply. He finally preferred Burro Mountain near the town of Tyrone, readily reached from Lordsburg or Silver City. It is of about 8,000 feet elevation and fairly well covered toward the top with medium-sized pines. Small oaks are scattered rather frequently lower down, and in summer, after the rains, grass and flowers spring up, so that the country, which is rolling, is very beautiful. The rainfall is expected to be not far from 10 inches annually, and more than half falls in the months July to September.

The United States Forest Service welcomed the establishment of the observatory and very helpfully improved a road quite to the site of the station. Water was successfully developed, in ample quantity and excellent quality, close to the road and about 2 miles from the summit. It is easy to truck sufficient water to the station.

J. Heather, of Lordsburg, contracted for the construction of the observing tunnel, dwelling houses, shop, and garages. Aided by a grant of funds from John A. Roebling, the work was completed in September 1938, and the equipment, formerly in Africa, was installed in October and November under the care of A. F. Moore, field director, and A. F. Froiland, assistant. Actual observations of the solar radiation will doubtless begin in December 1938.

Although a certain amount of skepticism still prevails among meteorologists as to the importance of the sun's variation for weather, it seems to the writer and to others with whom he has consulted that the results published by him in several recent papers [1] create a very strong presumption that the sun's variation is in fact the major cause of weather, and that if adequate observations of it were made, meteorologists the world over would be able greatly to improve their predictions.

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[1] Sun spots and weather, Smithsonian Misc. Coll., vol. 87, no. 18, 1933.

Solar radiation and weather studies, Smithsonian Misc. Coll., vol. 94, no. 10, 1935.

The dependence of terrestrial temperatures on the variations of the sun's radiation, Smithsonian Misc. Coll., vol. 95, no. 12, 1936.

Further evidence on the dependence of terrestrial temperatures on the variations of solar radiation, Smithsonian Misc. Coll., vol. 95, no. 12, 1936.

Cycles in tree-ring widths, Smithsonian Misc. Coll., vol. 95, no. 19, 1936.

Some periodicities in solar physics and terrestrial meteorology, Vestniku Ceskoslovenske fysiatricke spolecnosti v Praze, Rocnik XVIII, Cislo 1-2 (54-55), 1938.

FIG. 16.—Truck and water tank, solar observing station, Burro Mountain, N. Mex.

FIG. 17.—Road between instrument tunnel and dwellings, solar observing station, Burro Mountain, N. Mex.

W. H. Hoover occupied the Smithsonian station on Mount Wilson, May to October 1938, with two objectives: First, to grow plants in nearly monochromatic rays, selected from the solar spectrum; second, to measure the distribution of radiation in the spectra of the brighter stars by heat methods.

Plant experiment.—Mr. Hoover used a very large Christiansen filter in a solar beam reflected into the observatory from a coelostat. In that way he selected a narrow band of radiation in the blue. Peas grew in these nearly monochromatic rays for many weeks, until reaching a height of nearly a foot. It was hoped that blossoms would appear, but the experiment had to be closed before the plant was quite ready to blossom. Check experiments were made in ordinary daylight of about the same intensity. These check plants were a little more robust, but the continued growth of the plants in monochromatic rays for so long a period was surprising to many.

Star spectra.—Several nights observing with the 100-inch telescope were attempted. Ten small Christiansen filters were used to select narrow bands of spectrum at selected intervals between wave lengths 3400 angstroms in the ultraviolet and 10300 in the infrared. The intensities were measured with a vacuum thermopile of L. B. Clark's construction, connected to a vacuum, magnetically shielded, Thomson reflecting galvanometer mainly of Hoover's construction. The magnetic shield was designed by the late Elihu Thomson of Lynn. The galvanometer could be used in vacuum at 10 seconds single swing and observed at 5 meters scale distance. At this sensitiveness, currents of 1×10^{-13} ampere, or one ten-trillionth of an ampere, would be measurable.

In practice, however, it proved that the thermoelectric couples introduced too much drift for such extreme sensitiveness. The actual observing of stellar spectra was done at not above 4 seconds single swing of the galvanometer. But deflections as great as 20 millimeters were observed in the spectrum of the star Vega. It is believed that these experiments proved that when the 200-inch telescope is available, and with improved thermoelectric couples, and better insulation from temperature changes of the surroundings, it will be readily possible to use special diffraction gratings, and obtain continuous energy spectrum curves of the brighter stars, with photographic registration of the galvanometer deflections.

Hoover's curves are not yet all reduced. For the star Vega, however, his results are in very close agreement with those obtained by Abbot in 1928 with the fly-vane radiometer. But Hoover observed much farther toward the ultraviolet than Abbot, and he obtained more than 10 times as large deflections.

STUDIES IN ENGLISH GEOLOGY

By R. S. BASSLER
Head Curator, Department of Geology, U. S. National Museum

Field-work by members of the department of geology is usually devoted to the acquisition of new study and exhibition material, but occasionally some of this time must be employed in a search for knowledge to increase the scientific value of the existing collections. This is particularly true with regard to many of the invertebrate fossils collected by early students, who, for various reasons, did not record their geological formation and geographic locality with the accuracy required for the more detailed studies of the present day. Several decades ago a general label for the occurrence of a fossil was deemed sufficient, the identification of the species being regarded as the most important information. Fortunately, a study of the rocks in the identical or general localities from which the fossils were derived will often supply this missing information. During previous trips abroad, I visited classic localities on the continent partly for this purpose; but a vacation trip to England during the past summer, with the opportunity of traveling about quickly by automobile, permitted a study of some well-known southern England fossil areas extending from Cornwall on the west to the chalk cliffs at Dover. With London as a base, excursions were made to various parts of the English Lowlands, with brief intervals spent at the British Museum of Natural History checking the formation and locality occurrences of certain Paleozoic crinoids, and at the neighboring Geological Museum at South Kensington, inspecting the newly installed physical geology exhibits.

The field studies included first the Subcarboniferous Mountain limestone of the Avon gorge and the Mendip Hills areas near Bristol, which have produced many fossil crinoids. A visit to the great gorge through these hills at the latter locality (fig. 18) showed extensive outcrops of the crinoid-bearing strata, although specimens were not as common as the exposures would indicate. The gorge is of interest to the general public for its caves and a cleft in the rock which is said to have inspired the hymn "Rock of Ages," when its author was sheltered there during a storm. Arrangements were completed for securing casts of type specimens of certain little-understood crinoids from this area preserved in the Bristol Museum, in order that their structure now can be ascertained.

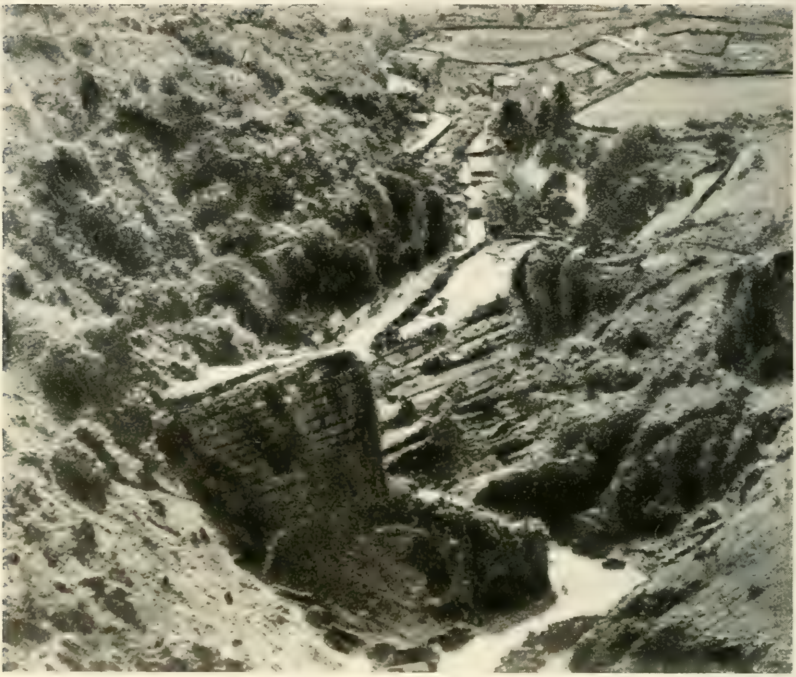

FIG. 18.—Cheddar Gorge of the Mendip Hills.

FIG. 19.—Lyme Regis, showing fossiliferous strata.

FIG. 20.—Stonehenge, Salisbury Plain.

FIG. 21.—The Dover chalk cliffs.

Proceeding southward through the cathedral town of Exeter, on the Exe River, Lyme Regis, the well-known Mesozoic fossil locality along the sea coast celebrated for its ichthyosaur remains, was briefly studied (fig. 19). Next, the city of Bath, the fashionable watering place located around the old Roman baths and in the center of the Jurassic oolitic limestone outcrops, was of especial interest. Here the houses built of white limestone and rising in successive terraces present a more striking and handsome appearance than in perhaps any other English town. Farther east, Salisbury Plain with its underlying chalk formation afforded numerous outcrops, although again fossils are not abundant. On the Plain, Stonehenge, the best-known example of the ancient builders' craft in Great Britain, erected by a race of Bronze Age people about 1500 B.C., is an object of much interest. Located just northwest of Salisbury with its dominant feature, the famous cathedral founded early in the thirteenth century, this more ancient temple was undoubtedly devoted to sun worship, since on the summer solstice the rising sun casts a shadow of the heel stone on the altar. The geologist found in tracing the origin of the stones, that the outer circle at Stonehenge (fig. 20) is made of blocks of Tertiary sandstone which once covered the Plain, while the inner circle and horseshoe are of igneous rocks which must have been brought from South Wales, 200 miles away.

South and east of London the chalk formation again comes to the surface with frequent outcrops for collecting, in the anticlinal uplift forming the Weald, bordered on the north and south by the Downs with their ever-present flocks of sheep. Eastward along the Weald the best exposures of the fossiliferous chalk beds and associated greensands are along the sea coast, where at Dover and Folkstone the geologist has ample opportunity for study (fig. 21). Return to London was made through the hop fields of Kent, where in September great numbers of pickers are busy. Here the London Basin with its Tertiary sediments affords outcrops of the more recent rocks of England. In a short time, therefore, one can review the entire geological column, by starting with the oldest igneous rocks in Cornwall, continuing with the lower and middle Paleozoic sandstones and shales in Devon, the upper Paleozoic limestone in Somerset and Gloucester, followed by the Mesozoic oolites and chalk beds from thence eastward through Canterbury to Dover, and ending with the Cenozoic clays and sands in the environs of London. Although invertebrate fossils needed to fill certain gaps in the study series were collected, the information obtained for more accurate labeling and for present studies was the most valuable result of this trip.

ANCIENT MAMMALS OF UTAH

By C. LEWIS GAZIN
Assistant Curator, Division of Vertebrate Paleontology, U. S. National Museum

The 1938 Smithsonian Institution expedition to Utah undertook principally to continue investigation of occurrences of the earliest mammals and lizards known from the State and to make a representative collection of upper Eocene fossils from the Uinta Basin. The party, consisting of George F. Sternberg, Harold R. Shepherd, and myself, met on June 1 at Price, Utah, and proceeded from there to the Uinta Basin in the northeastern part of the State. At Vernal, Utah, we were met by J. LeRoy Kay, of the Carnegie Museum, who had kindly offered to show us around the basin and point out the principal collecting localities. We spent 2 days in a pleasant and profitable reconnaissance of the region, marred only by our becoming mired in mud toward the end of the second day, when our host attempted to determine the speed of a horse which was running wild.

We left the basin on June 4 and turned our attention to the Wasatch Plateau country of central Utah. Our first camp was set up near a delightful spring on the ranch of George Olson in Joe's Valley. Exploration from this point consisted in reexamining the old localities which had been prospected by the Smithsonian party the preceding summer and in searching for new localities of fossiliferous Paleocene deposits. Our experiences in this mountainous country of few roads demonstrated the necessity of using horses, especially since the roads, though good when dry, can become impassable for hours or days after a little rain. Weather there during the summer months is continually unsettled.

We were fortunate in our prospecting in obtaining a much larger representation of the fauna from the Paleocene exposures in lower Dragon Canyon. Work in the Cretaceous of the same region was of considerable profit in finding additional material of the large lizard which Gilmore's party discovered the year before. One of the lizard specimens which we found is so nearly complete as to be worthy of permanent exhibition in the National Museum.

On June 25 we broke camp in Joe's Valley and transferred our attention back to the Uinta Basin. Camp was made at a locality known as Myton pocket, one of the well-known localities for fossil verte-

Fig. 22.—Carnegie Museum and Smithsonian Institution field parties at the Carnegie Museum Powder Springs camp in the Uinta Basin. (Photograph by Thompson.)

Fig. 23.—Smithsonian field party in the Manti Forest region of Utah. Horses were found to be indispensable in the search for fossiliferous deposits of Paleocene age.

FIG. 24.—The principal exposures of Paleocene beds from which nearly all of the mammalian material was obtained. Lower Dragon Canyon, Manti Forest, Utah.

FIG. 25.—Operation in the leptotragulid-homacodont quarry in Myton pocket, Uinta Basin.

brates of upper Uinta age. Carnegie Museum parties have in the past obtained a variety of the smaller mammals from beds at this locality. Our party was no less successful, and was particularly fortunate in opening a quarry for remains of small deerlike animals known as leptotragulids and homacodonts. Several weeks were spent in working the quarry, a job which was difficult, not so much in the amount of rock removed as in the care required in taking up delicate specimens from a well-indurated matrix.

The principal handicap encountered in working Myton pocket, and other Uinta Basin localities, was the remoteness of palatable water. Most residents in the vicinity of Myton drink water taken from the Duchesne River, after allowing it to settle, but it was so cloudy and distinctly alkaline that we preferred to haul ours from well supplies in the towns of Roosevelt and Fort Duchesne.

After 5 weeks at Myton pocket we visited several localities at more easterly points in the basin and made collections from a lower horizon known as Uinta B. Highly important for this early fauna is the locality known to paleontologists as "White River pocket," a small area of badlands near the junction of the Green and White Rivers and not far from the Ouray trading post. Of particular interest from this locality is the relatively rare *Epihippus,* a later stage in horse development during Eocene time. At least two skeletal portions and a few isolated jaws in our collection are believed from brief and unsatisfactory field identification to represent this early horse.

During our stay in the Uinta Basin we had the occasional and enjoyable company of Dr. John Clark and his graduate student assistant from the University of Colorado. Since their stratigraphic studies were carried on in the eastern part of the basin it was possible for us to join camps for a short time during our stay in Kennedy's Hole. The latter locality proved somewhat less productive of paleontological materials than we had anticipated, although we were much pleased at finding a large crocodile skull and jaws. Here, and in Coyote Basin to the south, the fossils are found principally in the heavier sandstone lenses and one notes a greater proportion of titanothere and rhinoceros remains.

On August 20 we broke camp in the Uinta Basin and hauled the bulk of our collection to Price, where it was boxed and shipped, and on August 23 proceeded to southwestern Utah to investigate a lava cave near Hurricane, reported to contain numerous animal remains. These proved to be of no great antiquity. The field season was terminated at St. George on August 25.

COLLECTING FOSSILS IN THE CATSKILLS OF NEW YORK

By G. ARTHUR COOPER
Assistant Curator, Division of Stratigraphic Paleontology, U. S. National Museum

On July 18 the writer set out for Stroudsburg, Pa., to join Dr. Bradford Willard, of the Pennsylvania Topographic and Geologic Survey, in a study of Middle Devonian (Hamilton) strata. After examining the section exposed about Stroudsburg, the party continued the investigation at Port Jervis, N. Y., about 40 miles to the northeast. Dr. Willard left the party here and the writer was then joined by Miss Winifred Goldring of the New York State Museum. In 1932 Miss Goldring and the writer studied the Middle Devonian sediments of Susquehanna and Schoharie Valleys on the north flank of the Catskill Mountains. These studies showed that the marine sediments about Cooperstown in the Susquehanna Valley interfingered with continental, deltaic beds toward the east, and led to the belief that a great thickness of the Catskills facing the Hudson Valley were of Middle Devonian rather than Upper Devonian age. To test this belief the party undertook a study of the eastern limb of the Middle Devonian outcrop from Stroudsburg, Pa., to Port Jervis, N. Y., and thence nearly to Albany. In this work the writer gratefully acknowledges the help of Mr. G. H. Chadwick, Catskill, N. Y., who assisted the party in the difficult problems of the continental sediments west of Catskill.

With the sequence at Stroudsburg as a guide, columnar sections were prepared of the rocks exposed along the Delaware River west of Port Jervis; in the Neversink Valley at Roses Point; along Rondout Creek above Napanoch; in Stony Hollow, west of Kingston; and up the Kaaterskill west of Catskill. It proved to be impossible to prepare complete sections of the Hamilton between Port Jervis and Napanoch because thick glacial deposits in Neversink and Rondout Valleys obscure the lower part of the Middle Devonian column. Middle and Upper Hamilton strata, dipping 13 degrees to the northwest, are well exposed from the west side of Port Jervis up the Delaware River to Sparrowbush and are about 2,600 feet thick. This section has many similarities to the marine sequence exposed about Cooperstown in Susquehanna Valley.

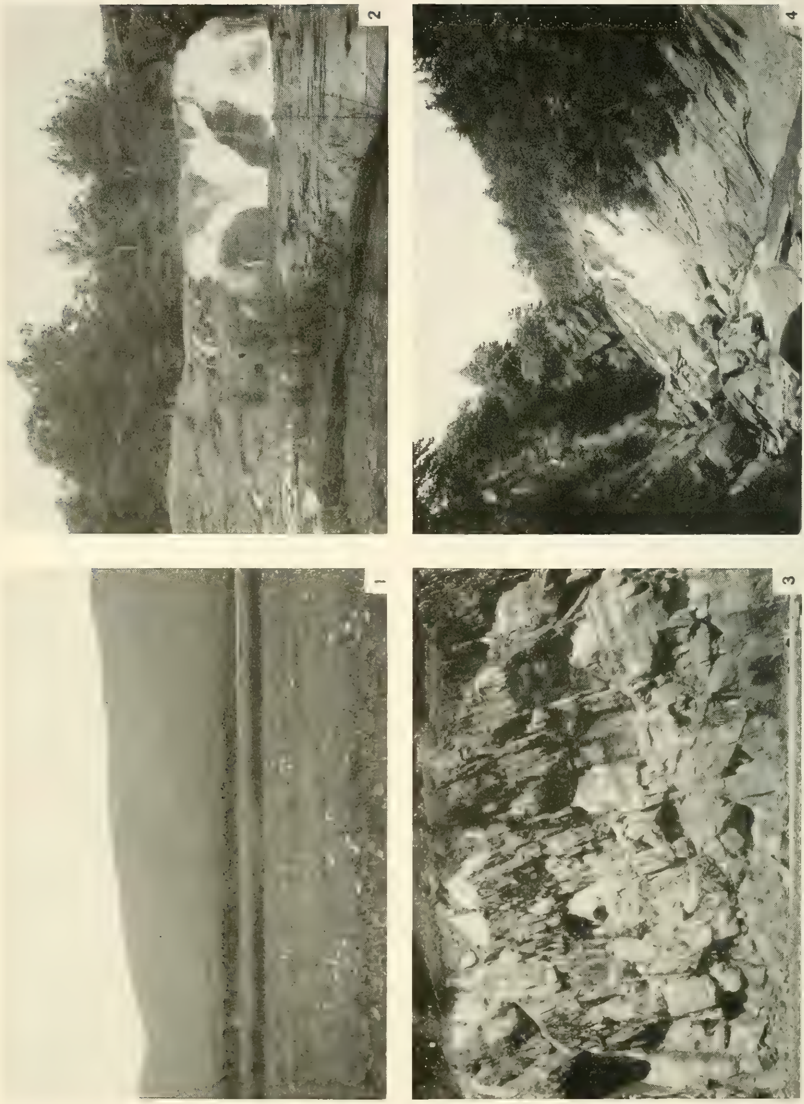

FIG. 26.—1, Mural front of Catskill Mountains, west of Catskill. Mountain House in upper left. Relief about 3,000 feet. 2, Lower falls on Rondout Creek at Napanoch, over fossiliferous middle Hamilton rocks. 3, Sandy limestone of Lower Hamilton age showing bedding (dipping to left) cut by strong cleavage. 4, Honk Falls, showing steep dip (37°) of plant-bearing upper Hamilton strata.

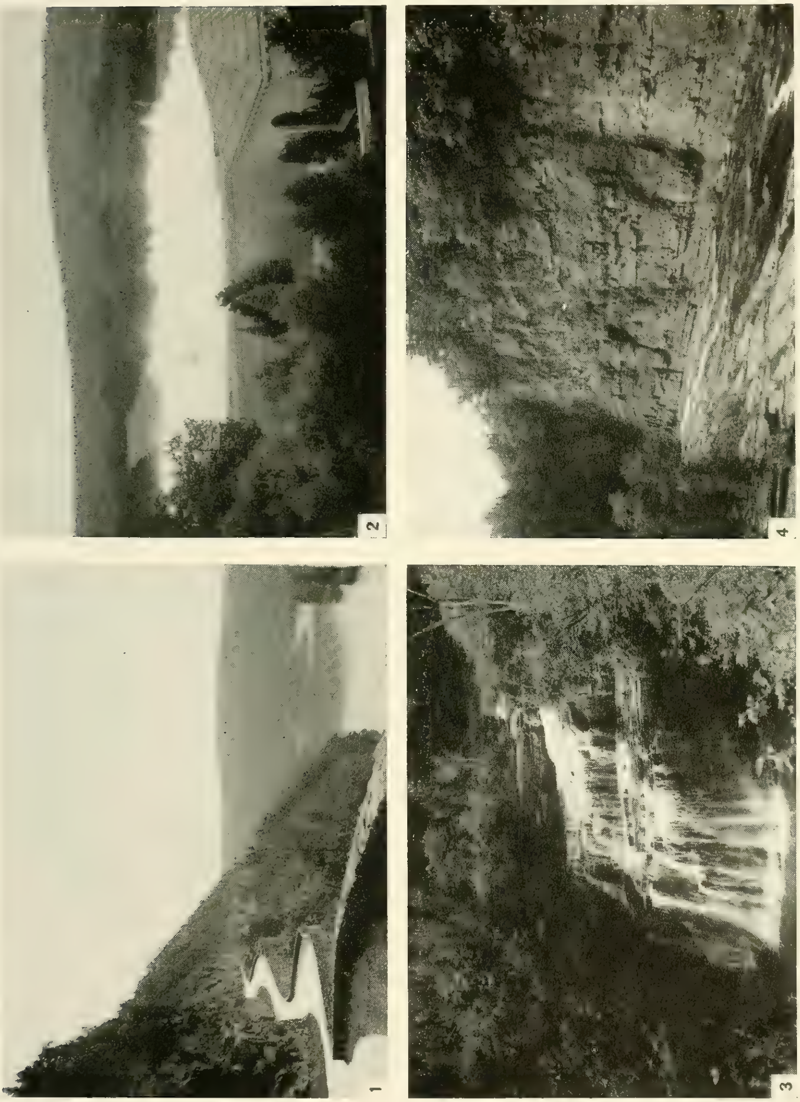

FIG. 27.—1, Looking down the Delaware River from Hawks Nest west of Port Jervis. 2, Aerators at Ashokan Reservoir. 3, Dickinsons Falls over Middle Devonian rocks, southwest of Albany. 4, Cliff of fossiliferous Hamilton (Mount Marion) rocks above Great Falls, southwest of Catskill, N. Y.

Northeast of Napanoch on Rondout Creek the dip steepens to 50 degrees or more to the northwest. The lower half of the exposed section abounds in marine fossils, but the upper half contains many fossil land plants. Nevertheless, a thin zone of Upper Hamilton marine fossils exposed at the top of Honk Falls gave a clue to the thickness in this valley, approximately 3,200 feet.

The dip of the beds lessens northeast of Napanoch to an average of about 5 degrees, and the outcrop widens. The upper part of the Hamilton changes to unfossiliferous, red, argillaceous sandstone and greenish, coarse or conglomeratic sandstone well shown around Ashokan Reservoir. Between these continental beds and the lower fossiliferous marine Hamilton rocks west of Kingston about 300 feet of bluish sandstone or "blue-stone" intervene. This rock, now called Ashokan sandstone, was extensively quarried about 40 years ago and formed the basis of the once flourishing "blue-stone" industry.

From Kingston nearly to Albany approximately the same sequence prevails: a lower part of about 1,000 feet of fossiliferous marine sediments (Bakoven and Mount Marion), then 300 feet of "blue-stone" succeeded by a great thickness of red-beds (Kiskatom) difficult to date because of absence of marine fossils.

An important part of this investigation was the determination of the thickness of red-beds belonging to the Middle Devonian in the mountains west of Catskill. In the absence of marine fossils, resort had to be made to comparison with other sections. The studies between Port Jervis and Kingston showed a continuously thickening sequence northeastward toward Albany, exactly the condition discovered on the north side of the Catskills between Susquehanna Valley and Albany. Therefore the section at Catskill must be at least as thick as that at Napanoch, where 3,200 feet of Hamilton sediments are known. Considerable thickening occurs northeast of Napanoch; hence it is concluded, on the basis of known rate of thickening that the Hamilton beds west of Catskill are much in excess of 3,200 feet, perhaps as much as 500 feet, putting the top of the Hamilton near the well-known Mountain House between 2,100 and 2,200 feet.

The results of this investigation thus corroborate the findings of 1932 on the north side of the Catskills. They also show that the marine beds of Stroudsburg and Port Jervis gradually change northeastward to nonmarine beds about Catskill. The northeastern portion of the Catskills is a great delta deposited from old highlands to the northeast. The delta sends out fingers of continental sediment into the marine beds west of the Catskills.

SOME EUROPEAN ZOOS

By WILLIAM M. MANN
Director, National Zoological Park
AND
LUCILE Q. MANN

The writers, having been given the Franklin Burr Award of the National Geographic Society, decided to devote this money to observation of some of the European Zoos we had not seen before, and of others where we knew that great progress had been made since our last visit to them in 1929.

On July 23, 1938, we were in Stockholm, Sweden, and went immediately to the great Skansen Park, a unique open-air Museum and Zoo. The animal collection was limited entirely to those living in northern Europe, all kept out of doors in naturally wooded paddocks where unusually fine specimens of each species were on exhibition. Outstanding were the European elks, eight of them in the collection, including a mother with twin babies.

In Moscow we found a large park of 32 hectares, and an enormous collection requiring a Zoo staff of about 500, including a number of scientists and women keepers. The Zoo is 75 years old, and has been greatly developed since 1924. Some two-and-a-half million people visit it each year to see the very splendid collection, mostly northern animals, but many of them of great rarity. The elephant display includes five specimens in a very large enclosure. Among the wild sheep were *Ovis poli* and fine markhors.

At Leningrad the Zoo is smaller than that of Moscow and 5 years younger, but contains also a good collection. We were especially interested in a black-cock or capercailye, the first we had ever seen in captivity, which had been kept alive by changing its food each month and giving it what it would find in nature with the changing seasons.

We were told that there are 26 Zoos in Russia, not including small, temporary Zoos which are established at children's rest camps and contain collections of baby animals for the children to play with. One cage that we saw contained baby lions and dingos together.

At Copenhagen a new bird house had been completed, and a large tropical house for giraffes was in process of construction. The bird house is especially attractive. Four years ago eight little lovebirds (*Agapornis personata*) were placed in a cage and there are now 120

FIG. 28.—Moscow Zoo: An artificial mountain, used in part as a tiger pit. The herpetologist's office is in a room in the highest peak.

FIG. 29.—Moscow Zoo: Children may rent carts drawn by horses, donkeys or camels, and have a race.

FIG. 30.—Moscow Zoo: Women keepers, as well as men, take good care of their animals. These two are engaged in raising sables, more than 20 of which were born and raised in the Zoo the past year.

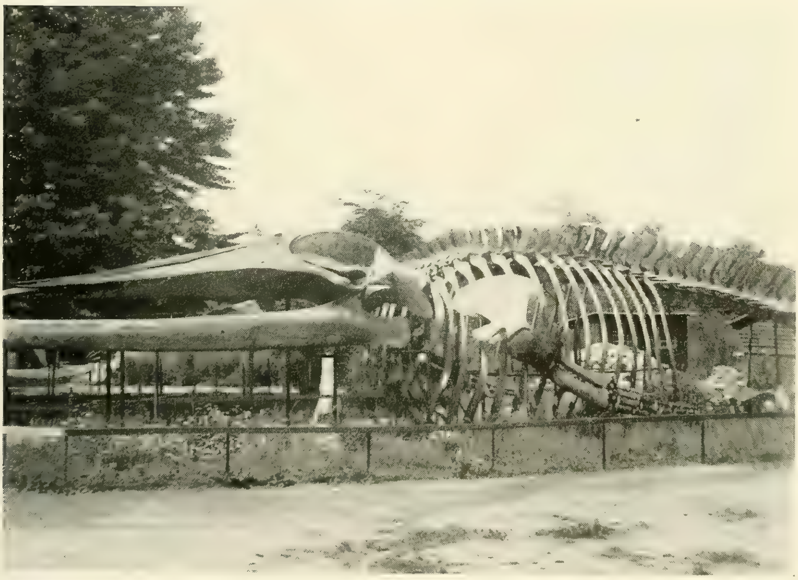

FIG. 31.—Copenhagen Zoo: Next best to a live whale in a Zoo is this 75-foot skeleton of a blue whale, exhibited in the open air.

of them, an astonishing increase. We saw an American bald eagle that had lived there for 55 years, and a family of European eagle owls with two babies hatched in the park.[1]

The Hagenbeck Zoo at Hamburg had made a number of the improvements that Heinrich Hagenbeck had told us about on our last visit 9 years ago. These included a wonderful barless enclosure where 10 elephants, of 2 species, made a great show. Twenty Patagonian cavies run loose around the grounds. The exhibition of seals is exceptionally fine and includes a sea leopard from Antarctica.

Hanover, a city of 550,000 people, maintains a fine Zoo under the direction of the Ruhes. Some of the buildings are new, and others date back 50 years and more. King William presented a lion house to the Zoo in 1867 and it still stands.

It would take a large volume to describe the Berlin Zoo. We lived there for 5 days and saw something different and spectacular each day. They had two gorillas and were raising a number of rare species. Crested partridges or roulrouls, Heck's Celebes ape, Gelada baboons, black leopards, and boatbills all had young born or hatched in the Park.

The Zoo at Nürnberg has not changed since 1929 because it is to be demolished and an entirely new one built. The new garden is to be 55 hectares, and to cost 4½ million marks at the start. We understand that 150,000 marks have already been appropriated for the purchase of new animals.

The Geo-Zoo at Munich, where the animals are arranged by continents, is a notable breeding establishment. Many species of native and foreign animals are allowed to run loose in the park, and although the number of species is not as great as in some other Zoos, the herds in general are much larger and most spectacular.

The new aquarium is superb, and the great-ape village with its various wings and large playgrounds for the chimpanzees, gibbons, and orang-utans, is the last word in quarters in which to exhibit and study these animals.

The Zoo at Zürich is only 9 years old and yet has developed remarkably. The animals' cages and enclosures are arranged in terraces on the side of a hill rising above the city. There is a good collection, including a pair of giraffes, a new lion house, and a splendid restaurant building.

Since we saw the Jardin des Plantes at Paris some years ago, it has been remodeled into a new and modern institution, with a big new

[1] Now on their way to the National Zoological Park.

FIG. 32.—Berlin Zoo: One of a half-dozen restaurants. In this, the visitor may obtain water in bottles from his favorite spa. It is also a popular place to take morning coffee.

FIG. 33.—Munich Zoo: In Europe the main road in a Zoo nearly always leads to the restaurant.

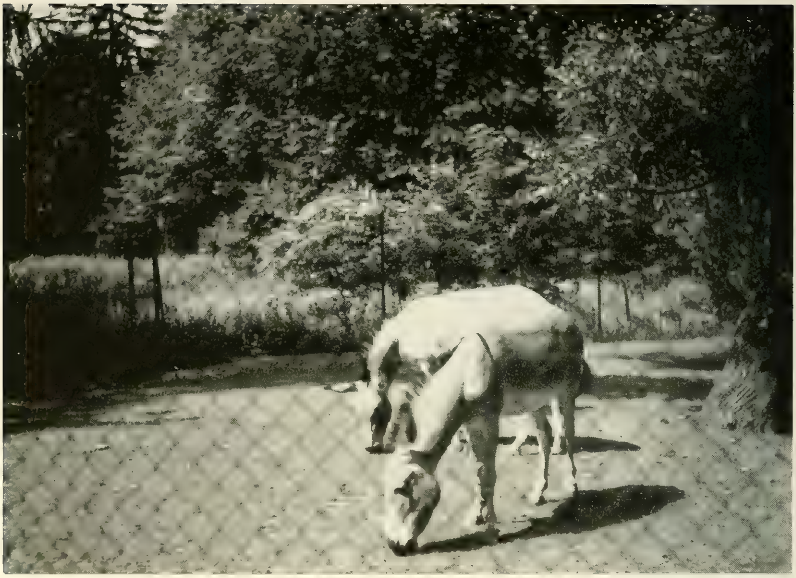

Fig. 34.—Munich Zoo: A pair of Nubian wild asses, for some reason among the most difficult animals to obtain. Munich had the only specimens we saw in Europe.

Fig. 35.—Vincennes Zoo: One takes an elevator on the inside of an artificial mountain, and from the peak, the highest point in the Zoo, gets a bird's eye view not only of the grounds below but of all of Paris in the distance.

FIG. 36.—Vincennes Zoo: The open air enclosures, surrounded by moats, make up most of the Zoo.

FIG. 37.—Dublin Zoo: A rocky road *in* Dublin being paced by two fine specimens of sloth bears.

lion house, a new monkey house, and a great collection of creatures. The vivarium built by Jeannel some years ago for the exhibition of insects, small reptiles, and batrachians, still stands out as unique.

The Vincennes Zoo, one of the newest in Europe, already contains a large and attractive collection, including an Indian rhinoceros and four giraffes. In addition to the exhibition areas, which are all of the open, barless type, the service quarters have been exceptionally well worked out.

The Zoo at Regent's Park in London impressed us as being "bigger and better than ever." Innovations are "invisible glass" fronts for bird cages, a modernistic ape house, and a special building to facilitate the work of artists in the Zoo. Among the rarest of the specimens on display were three giant forest hogs from Kenya—father, mother, and baby.

The new open-air Zoo at Whipshade, where 400 acres have already been developed and 200 acres more are ready for improvement, is outstanding. The animals are kept in great herds in large paddocks—20 tigers in one enclosure, for instance—and deer, pheasants, and cavies run wild in the forest. The restaurant is like a country club. This is the only Zoo in Europe that permits the entry of automobiles, and a fee of 5 shillings per auto, plus 1 shilling per person, is charged. It has become one of England's most popular resorts and picnicking grounds.

Edinburgh for many years has been famous for its penguins, and still is. Magellan and King penguins are raised each year, and one specimen has been in the Zoo since 1914. The Zoo itself is on a high hill, the top of which is covered with large paddocks for herds of ruminants. There were 11 chimpanzees and two orang-utans in the collection and a notable collection of carnivores.

The Dublin Zoo is the second oldest in Britain, having been founded in 1833 and maintained by the Royal Society with a grant from the Government. It is located in the beautiful Phoenix Park. This Zoo has always been famous for raising lions, and there is on exhibition a plaque with the pedigree of more than 160 lions that have been born there. Among the smaller fry there was a Tuatera lizard from New Zealand that has lived in the Park for 27 years, a record.

In general we found every Zoo that we visited thriving and all of them growing. In addition to the exhibiting of animals, interesting breeding experiments are being made. In Germany, through careful selection, are being recreated the extinct auroch and the wild wood-horse that formerly inhabited the country.

CETACEAN STUDIES IN EUROPE

By REMINGTON KELLOGG
Assistant Curator, Division of Mammals, U. S. National Museum

Late in the evening of May 12, 1938, the S. S. *Washington* of the United States Lines landed Mrs. Kellogg, Commander Wilfrid N. Derby, and me at Hamburg, Germany, after an interesting trip up the Elb River. The next morning, we were on the train bound for Sassnitz Hafen, where a small Baltic Sea steamer took us to Trelleborg, Sweden. Arriving at that port in the evening, we boarded the train which brought us to Oslo, Norway, on the morning of May 14. Having a few days at our disposal, we visited the Norsk Folkemuseum at Bygdøy. Many old buildings, brought from various parts of Norway, have been reassembled here and furnished with the handicraft, furniture, implements, and arts of the Norwegian people during the corresponding period. Here also, ancient Viking boats are exhibited in a large hall. Their amazingly well preserved contents, including among other things a wooden wagon, an elaborately carved bed, chests, sled, buckets, and other implements are displayed at the University Museum. The "Vi Kan" Exposition in Oslo had an exhibit of some of the apparatus used in modern whaling, which attracted many of the visitors. A day or so later, we were shown through the Institute for Whale Research at the University of Oslo by Prof. Johan Hjort. At Oslo, also, the youth parades and demonstrations on May 17, the Norwegian National Day marking the anniversary of the adoption of the constitution after the separation from Denmark in 1914, was a very gay occasion for visitors and residents alike. The visit to the well-known Norwegian whaling port, Sandefjord, arranged by the Norwegian Whaling Association, proved most interesting. Here we inspected some of the modern floating factory ships and a number of recent improvements in apparatus used in whaling operations, including the electric harpoon. At Sandefjord is located the Kommandør Chr. Christensen Hvalfangstmuseum, where there is on display, along with several kinds of whale skeletons, two huge iron oil-boiling pots left more than a hundred years ago by an American whaler on the Falkland Islands, many ancient types of harpoons, and other whaling accessories.

From Oslo, we took the train on May 29 for Stockholm, Sweden. There, through the courtesy of Count Nils Gyldenstolpe and Prof.

Fig. 38.—Sod-roofed farm house in Norsk Folkemuseum at Bygdøy, Oslo.

Fig. 39.—A fleet of killer boats at anchor at Sandefjord.

Fig. 40.—Three floating factories at anchor at Sandefjord.

Fig. 41.—Street separating two of the colleges at Oxford University, England.

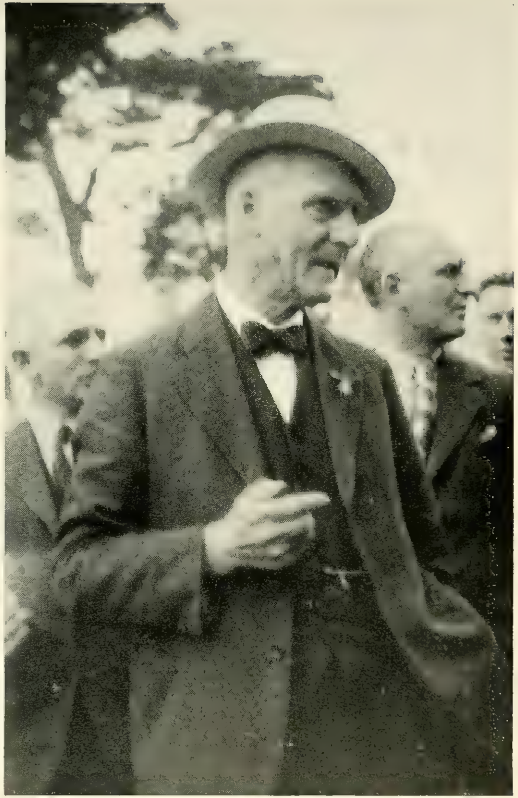

Fig. 42.—Sir Arthur Keith, pointing out spots where Charles Darwin conducted research on grounds surrounding his home at Downs, England. Distinguished anthropologist, anatomist, and former president of British Association for the Advancement of Science.

Einar Lönnberg, I was permitted to examine and study cetacean skeletal material belonging to the Naturhistoriska Riksmuseum at Freskati on the outskirts of Stockholm. In the well-arranged cetacean hall of this museum are exhibited a fine skeleton, including complete sets of baleen, of the now nearly extinct Greenland whale, as well as skeletons of the southern right whale, Atlantic right whale, blue, finback, Bryde's whale, sei whale, little piked whale, bottlenose and other beaked whales, killer and southern right whale porpoise. The Nordiska Museet, with an indoor section recreating Sweden's past cultural history and an out-doors section, Skansen, located on a high elevation overlooking Stockholm, which is a living museum, give the visitor pleasant impressions of old Swedish folk life. From Stockholm I made a side trip to Uppsala where I was enabled to examine, in the Geological Institute of the University, the subfossil remains of a whale from Gräsö, Gulf of Bothnia, that formed the basis for Lilljeborg's *Eschrichtius robustus*. These bones exhibited the characteristic features of the present day North Pacific gray whale.

Leaving Stockholm on June 2, we traveled by train to Malmö and thence by ferry to Copenhagen. In the absence of Dr. M. Degerbøl, Dr. F. W. Braestrup showed me the cetacean material that I wished to examine. The University Zoological Museum possesses an excellent though very much crowded collection of cetacean skeletons, including an adult male Greenland whale, a large male sperm whale, an exceptionally large hyperoodon, and more than 65 mounted skeletons of toothed whales, ranging in size from the small harbor porpoise to killer whales. At the Geological Museum, Prof. J. P. J. Ravn was kind enough to show me the fossil cetaceans that had been found in Denmark.

It was necessary for us to return to Oslo to make arrangements for the journey to England. We left Oslo at the time the trees were fully leaved and the lilacs in full bloom. As we traveled toward Bergen on June 6, our train climbed gradually to an elevation of 4,000 feet, where winter still held its grip. Not a vestige of a budding shrub was visible, and the ice, snow, and shadows cast an unforgetable pattern of black and white on the hill slopes. The descent from the summit carried the train through several long tunnels. When the mist had cleared from our compartment windows we saw pussy willows and the unfolding buds of birch trees. We had thus witnessed spring for the third time this year: at home before sailing, at our arrival in southern Norway, and here once more near Bergen.

The day following our arrival at Bergen, we visited first the Hanseatiske Museum and the restored row of old hanseatic houses along

the quay, facing the open fish market, and later the medieval banqueting room of King Håkon's Hall which has been restored and decorated with colorful designs by the artist, Gerhard Munthe. A good view of Bergen and the fjord was obtained by taking the steep funicular railway to the heights above the city. An appointment was made with Prof. August Brinkmann to visit the Bergen Museum late that afternoon. At least 6 skeletons of as many kinds of whalebone whales, and between 50 and 60 skeletons of toothed whales, of which about 40 are killer whales, are possessed by this museum.

On the morning of June 9 we sailed from Bergen, Norway, on the S. S. *Vega* and arrived the following morning at the Tyne Commission Quay near Newcastle, England. Dr. John Beattie, conservator of the Museum, Royal College of Surgeons, and Martin A. C. Hinton and Dr. Francis C. Fraser, of the British Museum (Natural History), made it possible for me to examine a series of skulls and skeletons of porpoises in a relatively short time. To Dr. Beattie and Sir Arthur Keith, I am indebted for the invitation to visit the research laboratory of the Royal College of Surgeons at Downs and the home of Charles Darwin.

Finally, we visited Edinburgh on May 29, where we were the recipient of many courtesies from Prof. James C. Brash of the Department of Anatomy, University of Edinburgh. The Anatomical Museum of the University of Edinburgh has a larger and more complete collection of Cetacea frequenting Scottish waters than any other institution in the British Isles. This museum contains a number of historic anatomical and osteological preparations which were acquired during the periods of activity of Sir Robert Sibbald, Dr. Robert Knox, Sir John Struthers, Dr. William Turner, and others. The exhibits and study collections of the Royal Scottish Museum in Edinburgh were shown to us by A. C. Stephen, keeper of zoology. A day later we were back in London and embarked the following day on the S. S. *Manhattan* at Southampton.

As regards kinds of whales and number of specimens representing each kind, the cetacean collections of the British Museum (Natural History) at London, the University Zoological Museum at Copenhagen, and the Naturhistoriska Rijksmuseum near Stockholm are unsurpassed by any of the American collections. Although these museums were visited primarily for the purpose of examining skeletal material of whales not represented in American collections, advantage was taken of large series of some kinds of cetaceans to appraise the range of individual variation in diagnostic structures. These superb

and well-rounded cetacean collections have been assembled only by close cooperation between the museums and agencies in a position to assist with the collection of such material. Of all the European museums, the British Museum (Natural History) in London is probably the most active at present in building up the cetacean collections. Besides older material, some of which dates back a century or more, this collection has been augmented from time to time by specimens

FIG. 43.—Home of Charles Darwin.

received from various exploring expeditions. The British Museum has profited greatly since 1912 by the arrangements made by Sir Sidney F. Harmer with the Receivers of Wrecks and with the Coast Guard Officers for the receipt of telegraphic reports of all strandings of whales on the British Isles. The staff of the "*Discovery* Expedition," organized for whaling research under the auspices of the British Colonial Office, have transmitted numerous cetacean specimens, and British whaling vessels have assisted in a similar manner.

A SEARCH FOR BIRDS AND MAMMALS IN KENTUCKY

By W. M. PERRYGO
Scientific Aid, Division of Mammals, U. S. National Museum

Kentucky has long remained a section whose bird and mammal life was represented in the United States National Museum by few specimens, so that it was with interest that I undertook a survey that was to cover much of the State. Arrangements were made with Maj. James Brown, Commissioner of Game and Fish, Department of Conservation, for the necessary permits, and through his kind offices we received aid without which the work could not have been successful.

With James Cole as assistant, I left Washington on April 15, 1938, to begin work a few days later near Brandenburg, in Meade County, in a region of rolling hills and the level bottomlands along the Ohio River. We remained here for 2 weeks collecting many interesting specimens, including the Bachman's sparrow, and various kinds of mice.

Leaving here we went to the extreme southwestern part of the State, near the Mississippi River, to investigate an area in the Austroriparian life zone at the northern end of Reelfoot Lake. Only a small portion of the lake, or the arms, as they are locally called, extends across the State line, but our observations gave much of interest to supplement the material obtained last year in the adjacent Tennessee section. Our collecting here was done in beautiful cypress swamps and around the edges of the many cotton fields.

We moved then to Monticello to investigate the dry oak-wooded hills of Wayne County and then, working our way northward into Harlan County, put up in an abandoned C. C. C. camp near Cumberland. This gave us easy access to Black Mountain, southeast of Lynch, the highest mountain in the State, with an altitude of 4,150 feet. Black Mountain is unlike the higher mountains of West Virginia and Tennessee in that it lacks the typical Canadian zone, having no spruce or balsam trees. Here, in spite of continuous rains and dense fogs, we obtained many interesting specimens, one being a new type of red-backed mouse. This was our first experience in catching mice of this group in flying squirrel traps set on trees.

After 2 days' work on Pine Mountain, in Letcher County, we moved northeastward to Belfry, a mining town in Pike County, where

FIG. 44.—On and near base of trees where type of new red-backed mouse was taken. Black Mountain, Ky.

FIG. 45.—Looking east from Black Mountain.

FIG. 46.—The Ohio River near Owensboro, Ky.

FIG. 47.—Our camp near an Indian mound at Fullerton, Ky.

we spent the week of July 4, Cole collecting in Kentucky, while I crossed to secure certain desired specimens of birds from Wayne, Logan, and Mingo Counties in West Virginia.

Our work completed here, we moved to Lewis and Greenup Counties, pitching our tent beside an Indian mound at Fullerton, for work along the Ohio River. This completed the investigations for the early part of the season, and we returned to Washington July 15.

Accompanied by Herbert Deignan, of the Division of Birds, and Gregor Rohwer, I left for the autumn collecting trip on September 15. At Middlesboro we obtained permission from the American Association Coal Company to investigate the deciduous forests covering Log Mountain whose summit rises to approximately 3,100 feet above the sea. We had a profitable 2 weeks here, with the birds and mammals typical of mountains of this altitude. While here we were joined for a few days by Dr. Alexander Wetmore.

Leaving Middlesboro on October 1, we moved to Rockcastle and Madison Counties, collecting south of the college town of Berea. A considerable part of this region, with an altitude of 1,000 feet, is flat with poor drainage, forming many wet meadows. This made it an excellent country for marsh wrens, Savannah sparrows, and many other birds and mammals.

We moved from here to the Ohio River south of Covington, to catch the fall migration along the Ohio and its lowlands. Here we secured the long and short-billed marsh wrens, American bittern and coot in the cat-tail marshes, while along the bluffs and rolling hills near the river were various wood and field birds.

On October 15 we journeyed to Madisonville to examine the low cypress swamp country in Hopkins, McLean, and Muhlenberg Counties. Although swamp rabbits occur here, they were scarce, and we were unable to get any. However, we did find LeConte's sparrows and the prairie horned lark. The lespedeza (Japanese clover) recently widely distributed in this county made good feeding ground and cover for marsh wrens, sparrows, and many other birds.

The Cumberland and Tennessee Rivers which flow northward into the Ohio River run near and parallel to each other in Trigg County, where we spent a successful week collecting in the bottomlands. Here we saw several swamp rabbits in patches of cane.

Our last week was spent in the cedar-covered hills and in the farmlands of the Mammoth Cave area in Edmonson County, and on November 15 we were once more in Washington.

COLLECTING TURTLES AND FISH IN FLORIDA

By C. R. ASCHEMEIER
Taxidermist, U. S. National Museum

Having planned a trip to Florida in February 1938, I was requested to extend my stay there for a couple of weeks for the purpose of collecting turtles and fish for the National Museum.

I arrived at Gainesville on February 21 and through the kindness of Dr. Van Hyning, Director of the Florida State Museum, and with the generous cooperation of members of his staff, I established headquarters there. I then proceeded to Cedar Key, approximately 50 miles southwest of Gainesville on the Gulf of Mexico, where I collected both fish and turtles. Having on several previous occasions visited this quaint old fishing town to collect porpoises for the Museum, I was given valuable assistance by old acquaintances. Some large fish, among them red snappers, kingfish, mackerel, sheephead, and mullet were taken, mostly for their otoliths, while from the small pools left by the receding tide several hundred smaller fish were collected.

A rare opportunity to get some turtles easily was unfortunately missed here. I had visited Lake Johnson to catch some large black bass, and during my absence a fisherman, being unable to get a haul of fish, decided to haul his seine for sliders or "streaked-headed cooters" as they are called by the Floridians. He was very successful in this respect, bringing in about 75 turtles. On hearing this I hurriedly looked up the captain of the boat but found he had disposed of the lot. Together with the proprietor of the hotel I then made a house to house canvas for turtles and managed to get three specimens. Sliders are preferred to chicken by many of the inhabitants; I have myself feasted on turtle stew several times and can pronounce it delicious. Three diamond-back terrapins were obtained at the mouth of the Suwannee River, at which place the sliders also were collected.

After spending a week at Cedar Key I went to Tallahassee where, with the kind assistance of my friends, Dr. Herman Gunter and a member of his staff, Mr. Clarence Simpson, arrangements were made which resulted in the collection of a fine series of turtles at the neighboring Lakes Jackson and Iamonia.

The lakes of Florida are variable in origin and development as well as in other characteristics, and during my visit I became acquainted

FIG. 48.—View of Lake Iamonia, Fla. Taken before the water disappeared.

FIG. 49.—View of Lake Iamonia, Fla., after the water disappeared.

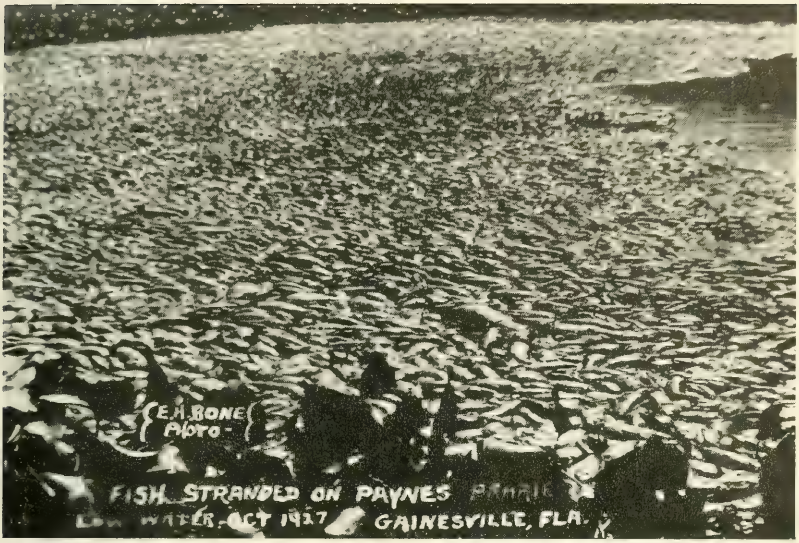

FIG. 50.—Thousands of fish stranded around the "sink hole," Paynes Prairie, showing how the lakes of Florida teem with fish.

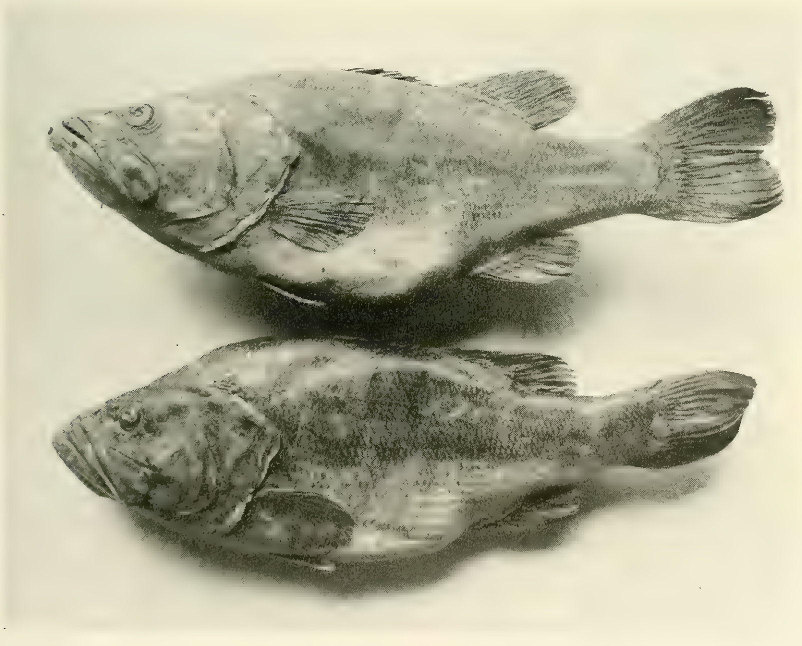

FIG. 51.—Two large-mouth black bass. Taken in Orange Lake, Fla., with artificial plugs or bait.

with what are known as "disappearing lakes" and witnessed the disappearance and reappearance of two of them—Lake Iamonia, 18 miles north of Tallahassee, and Alachua Lake (also known as Paynes Prairie) 4 miles east of Gainesville. Under normal conditions these lakes of considerable area are filled with clear water and abound in fish of various kinds. In most instances after disappearing they refill slowly, depending upon the rainfall; some have remained dry for years. I have seen fish lying dead by the thousand in the beds of these lakes after the water has drained. The area surrounding these sinks is more or less cavernous, with perhaps developed channels for a greater

Fig. 52.—The beach at low tide, Daytona, Fla.

or less distance in the subsurface limestone. Thus the small area of surface water and the subsurface solution channels afford a harboring place for a number of the fish and other aquatic life until such time as the lake refills.

It so happened that during part of my stay at Tallahassee and vicinity the weather was cool and the turtles did not show themselves very often, but with the help of "Mose," a local farmer, and a leaky rowboat, I managed to collect a total of 12 turtles at Lake Iamonia, and with the cooperation of Dr. Gunter and Mr. Simpson, about 20 turtles from near Tallahassee. Altogether I obtained 28 turtles and 1,862 fish, among which were two large-mouth black bass weighing 10 pounds 2 ounces and 10 pounds 3 ounces respectively and considered very fine specimens.

THE FRESH-WATER FISHES OF VIRGINIA

By LEONARD P. SCHULTZ
Curator, Division of Fishes, U. S. National Museum

During 1937 and 1938 Earl D. Reid, also of the Division of Fishes, and the author spent 4 weeks on four different trips for the purpose of collecting fishes in Virginia. This field-work is preliminary to the laboratory study of Virginia fishes. The Smithsonian Institution furnished the traveling expenses for this field-work, and we hope to continue our investigations until the entire area of the State has been explored. Collections have been made in the smaller streams and rivers of far western Virginia, along the southern border of the State, in the Pamunkey and Rapidan river basins, and in numerous tributaries of the Roanoke, James, and New Rivers.

In Lewis Fork, a tributary of Fox Creek, near Mount Rogers, figure 53, several small native *Salvelinus fontinalis* were collected. It would have been impossible for us to have made this collection except for the guidance of J. M. Reeves, game warden at Galax. The splendid cooperation of M. O. Hart, Executive Secretary, Commission of Game and Inland Fisheries of Virginia, and of various game wardens has made possible, and pleasant, our field-work in the State.

Two conclusions are apparent from our field-work. First, fish-life is abundant in the upper courses of the streams in the mountainous areas, where the bottom offers protection for fish and is suitable for the production of fish foods. Such a stream is Crooked Creek, near Galax, figure 54. Second, there is a great scarcity of fish in those sections of many streams that have shifting sand bottoms, such as Leatherwood Creek, figure 55, east of Martinsville. In other similar streams no fish were taken by seining for a distance of half a mile.

An interesting discovery was made in the distribution of the mountain sucker, *Thoburnia rhotheca,* formerly known only from the James River system, but taken by us in the headwaters of the Mayo River, a tributary of the Roanoke system. Figure 56 shows one of us seining for this sucker in swiftly flowing water. Other unique fishes also have been collected by us, such as *Parexoglossum laurae* Hubbs, known only from the New River system, a cyprinid with a very peculiar mouth (fig. 57, A) resembling that organ in *Exoglossum maxillingua* (Le Sueur) (fig. 57, B). The latter species is commonly taken in the coastal drainage of Virginia, but not in the New River.

Fig. 53.—Lewis Fork, of Fox Creek, near Mount Rogers, Va., from which native brook trout, *Salvelinus fontinalis,* were taken. (Photograph by E. D. Reid.)

Fig. 54.—Crooked Creek, near Galax, Va. Many species of fish are found in this creek because of a fair quantity of food organisms on the gravel bottom. (Photograph by E. D. Reid.)

FIG. 55.—Leatherwood Creek, east of Martinsville, Va. This stream has a bottom of shifting sand which makes food organisms scarce and in such areas practically no fish were found. (Photograph by E. D. Reid.)

FIG. 56.—Seining the mountain sucker, *Thobunnia rhotheca,* near Stuart, Va. (Photograph by E. D. Reid.)

Several times I have heard accounts of spiders as fishermen, but not until this summer did I have the opportunity of verifying them. On the afternoon of October 12, in Marsh Run, about 9 miles west of Orange, Va., while sorting fish from leaves, some specimens were overlooked and tossed back into the creek along with the leaves. The minnows were alive, but sick, a few floating near the surface in normal position while they were recovering. A little later I saw a spider, subsequently identified by Dr. E. A. Chapin, Curator of Insects,

FIG. 57.—A, the underside of the head showing the mouth of the cyprinid *Parexoglossum laurae* Hubbs; B, the mouth of *Exoglossum maxillingua* (Le Sueur). Both reproduced by permission of Dr. Carl L. Hubbs.

U. S. National Museum, as *Dolomedes tenebrosus* Hentz, a few inches above the water line, with a minnow about 3 inches long, no doubt one of the sick fish released by us, held in its chelicerae. Upon my attempt to capture the spider and the fish, the former carried its victim a foot and a half up the vertical bank at which point both were forced into a collecting can. The minnow was held by the mid-dorsal region of its back, its head extended in front, and its tail backward, between the legs of its captor. The spider measured $3\frac{1}{2}$ inches from tip of one leg to the tip of the opposite one.

CRUISE TO NORTHWEST GREENLAND, 1938

By CAPT. ROBERT A. BARTLETT
New York City

I am always glad to go north for the Smithsonian because they think of so many interesting things to look for. They gave me a long list this year: walrus pups, narwhals, porpoises, birds, marine invertebrates, and plants. Not only were birds desirable, but their skeletons and stomachs as well. A lot of useful information has come out of the "innards" of birds, for we know so little about their feeding habits and migrations which can often be traced through the food found in the crop.

We had a complete outfit, thanks to a visit made to the National Museum by David Nutt, who took charge of the collecting. While at the Museum, he went over all the work in detail, and as a result, he turned in the best collections we have made in many years. Including David, there were 13 young men who contributed toward the success of the expedition, both financially and by pitching in to do their share of the work. These were: David C. Nutt, Cleveland, Ohio; Warner Kent, Scarsdale, N. Y.; Albert Hoffman, East Norwick, Long Island, N. Y.; Leo Silverstein, New York City; Ray Hellmann, Scarsdale, N. Y.; Arthur DeForest Manice, Old Westbury, Long Island, N. Y.; George Moffett, Queenstown, Md.; Hugh Byfield, Middleburg, Va.; Arnold Knauth, New York City; Dr. Moore Moore, Jr., Surgeon, Presbyterian Hospital, New York City; Don Clark, Radio, New York City; Bob Wurtz, Millburn, N. J.; and Rupert Bartlett, Newfoundland.

Surface thermometer readings during each three hours were taken for the Hydrographic Office, and ice data were supplied to them daily by radio. Drift bottles with Hydrographic Office papers and data sealed in them were thrown overboard, to become the sport of winds and currents. During the many years that I have been in the eastern and western Arctic in the *Morrissey* we have always done this, but not until 2 years ago, when we obtained some special sealing wax from Captain Hellweg, Superintendent of the Naval Observatory, did we begin to have good results. Now many more of our bottles are heard from again. Our instruments, also, are obtained from the Naval Observatory.

Fig. 58.—The *Morrissey* laying to in loose ice.

Fig. 59.—The north shore of Makinson Inlet, Ellesmere Land.

FIG. 60.—David Nutt inspecting the jars of material gathered in dredging with the otter trawl.

FIG. 61.—Repairing our otter trawl.

On June 19 we left the McWilliams Shipyard, West Brighton, Staten Island, arriving at Brigus the first week in July. Here David Nutt and Ray Hellman collected birds. At our next stop in Labrador, birds and plants were collected, and the freshwater pools were searched for fish and smaller creatures of various kinds.

While we did not encounter ice in crossing from Labrador to Godhavn, Greenland, we were always near it, and when the visibility is poor, a thermometer is to the mariner what the trained dog, or "Seeing Eye," is to a blind man. Coming north over the West Greenland fishing banks, we saw many Portuguese and French fishing vessels, but there were no cod because of the nearness of the west coast ice.

We stayed a few hours at Godhavn, only long enough to get fresh water and fill our oil tanks from the barrels carried on deck. Governor Rosendahl, as usual, did all he could to make our visit a success. Here again David had a chance for some collecting.

As the National Museum was very anxious to obtain specimens of young and female narwhals, of which they had none in their collections, we persuaded several natives to go hunting with us in Inglefield Gulf. Two females and one young were taken, also two males, of which the larger had a tusk 7 feet long. It is the largest narwhal ever to come to the National Museum. They are most interesting animals, with their long tusk, which is an enormous, spirally elongated development of a tooth. This tusk is apparently of no particular service to the animal, and being very brittle, it snaps off easily whenever it strikes anything hard.

In Smith Sound we obtained our two walrus pups, and also had the good fortune to pick up skulls of three females which the Museum was glad to have for study purposes. Looking for the herd consumed much time. Once the pups were on board, we built a large wooden tank, caulking it to make it tight, so that the little fellows would have plenty of clean salt water. We gave them all the fish, milk, and meat they could stand. Keeping them in plenty of salt water where they could swim about and dive for their food was good for them. They were a joy to have and gave us lots of fun.

Around Cape Alexander, Greenland, and in Murchison Sound we used the otter trawl, and so obtained a great deal of marine life from the sea floor. Trawling is a fascinating operation. All our boys were enthusiastic about it, especially when the net arrived on deck.

Our farthest north was a few miles south of Cape Sabine. From Cape Sabine to Cairn Point the ice was in large, heavy, unbroken sheets.

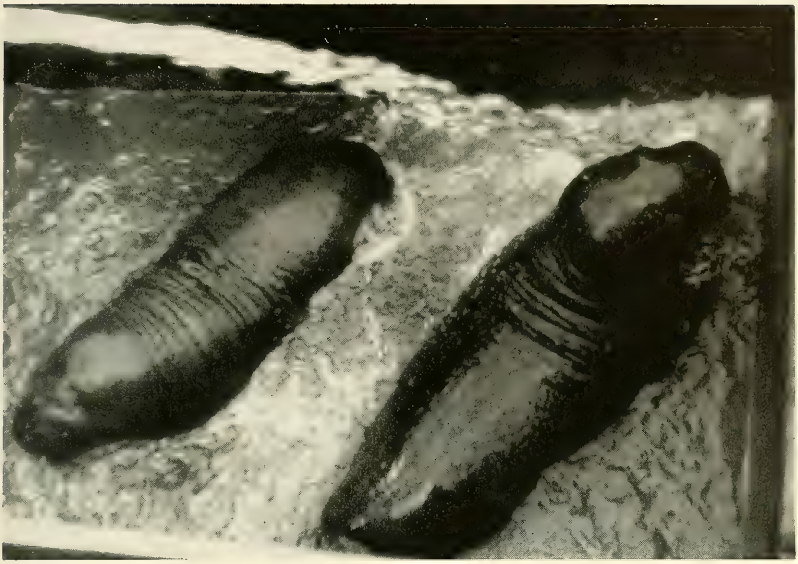

FIG. 62.—The two walrus pups resting comfortably at bottom of tank on deck of the *Morrissey*. The water had been drained off for a short time.

FIG. 63.—A polar bear wondering what all the noise is about.

On the way home we followed the coast of Ellesmere and Baffin Land. Off Talbot Inlet we got eight ivory gulls. This is a bird of the high latitudes and so is very rarely collected. The Museum has never had skeletal material of this gull, and the scientists there were pleasantly surprised to receive a series of specimens such as they hardly ever expected to see. We were also able to get some other desirable birds: purple sandpipers, dovekies, and Mandt's guillemots.

Strong easterly gales in the early spring cleared the ice out of Melville Bay, leaving large stretches of open water. These were followed by southerly gales, raising big swells, which, in turn, broke up the shore ice along the Canadian shore. Under these conditions, we were enabled to go close in to the shore and, entering Makinson Inlet, found it as free of ice as the Potomac in August, except, of course, for the bergs from the glaciers that adorn the shores of this seldom-seen fiord. I believe that the *Morrissey's* keel is the first that has graced these waters. The scenery, rivaling the fiords of Greenland, held us spellbound. We steamed for five hours in this grand fiord before returning to the mouth of it and continuing on south.

The only landing made on Canadian soil was in a snug, deep-water cove inside the point that makes Isabella Bay, where in a strong wind and snowstorm we anchored in 24 fathoms of water on a soft bottom. Some of the lads went collecting, while the others helped with the watering. At dawn next day we hove up the anchor and for an hour or two steamed down the bay. There is nothing like a sunrise in this north country. It was an unforgettable sight, with the sun spreading its golden rays across the snow-clad mountains made whiter by the new-fallen snow. As the morning wore on, a pearly mist arose from the valleys toward the blue sky above, and the haze assumed a purple tint away to the northeast. It reminded one of a vale in Kashmir.

For several days we cruised along the coast, stopping to take note of anything interesting. I had hoped to visit Totness Roads in Exeter Bay, but the opportunity of getting south in good weather was too good to miss. There was a great deal of ice on the outside, and any wind from the northeast would block our way to the south.

West of Cape Sable Island we got a male porpoise and a little later picked up our second one, a female from south of Nova Scotia. The National Museum is as anxious to obtain porpoises as any other animals that I got, because so little is known about their distribution and so few are ever collected.

At length we reached New York ahead of the disastrous New England hurricane with all the boys in good health and no accidents to them or to the schooner.

THE BUTTERFLIES OF VIRGINIA

By AUSTIN H. CLARK
Curator, Division of Echinoderms, U. S. National Museum

Just because a certain kind of butterfly happens to be common in a given region it does not necessarily follow that it is really at home there. It may be a visitor. Regular summer visitors are rather numerous among Virginia's butterflies, including some of the commonest among them. All of these come from the south. Straggling individuals in the spring wander north from the Carolinas or from Tennessee and lay their eggs on the proper food plants. By the end of the season their descendents may be abundant over the whole State.

On looking over some thousands of records, we find that the least sulphur (*Terias lisa*), one of the very commonest butterflies in late summer and autumn, has never been found in Virginia before the end of May, when the second brood begins to appear. It is, therefore, only a summer visitor. All of the millions of individuals in the State die during the winter. Another butterfly very common all over Virginia in late summer is the buckeye or peacock (*Precis coenia*). For this also our earliest records are in the latter part of May. But by the middle of July the buckeye is a familiar insect everywhere. These two are samples of the regular summer visitors from the south, butterflies that every year become abundant in Virginia, only to be killed out at the end of the season by the winter's cold.

Some visitors come from more distant regions. As an example, there is the painted lady (*Vanessa cardui*). This is the most widely distributed of butterflies. It is found all over Africa and over very nearly all of Europe and Asia, excepting the plains of India. In North America it has been captured in Alaska and in the region of Hudson Strait. It reaches Iceland more frequently than any other butterfly. Yet in North America it is not known to be a permanent resident anywhere north of Mexico. From its home in Mexico it is constantly wandering northward, establishing itself temporarily all over the United States, and even in Canada.

Other visitors from the southwest find their way to Virginia. Some are very unusual, like the Ontario hairstreak (*Strymon ontario*) and the early hairstreak (*Erora laeta*), but others are more familiar. Once in a while wholly unexpected visitors turn up, usually from the south,

FIG. 64.—The southern monarch, *Danaus plexippus nigrippus,* Spring Grove, Surry Co., Va., June 15, 1938. This southern form differs from true *plexippus* in having the apical portion of the fore wing dark, the subapical spots white or nearly white, and the small white spots in the black border of the hind wing obsolescent.

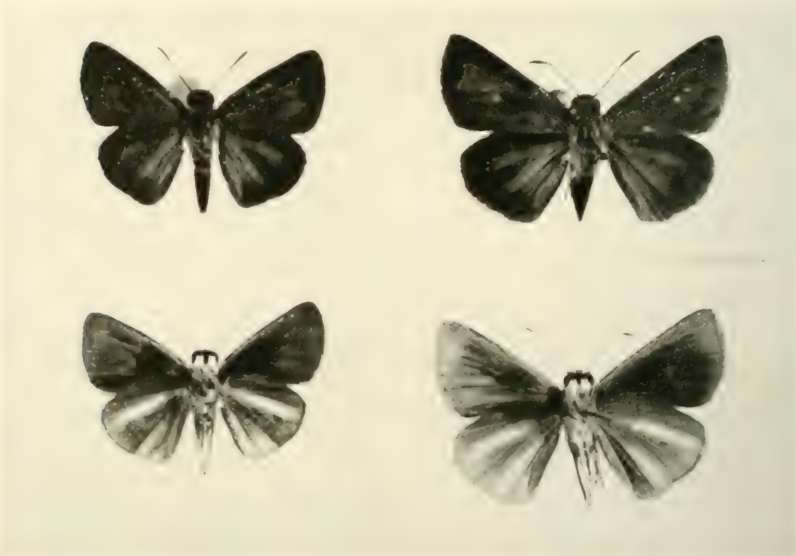

FIG. 65.—Dukes' skipper, *Atrytone dukesi,* male (left) and female (right), upper (upper) and under (lower) sides, Pocaty Creek, Norfolk Co., Va., June 14, 1938. A rare butterfly in collections, known hitherto only from Mobile, Ala.

FIG. 66.—The viceroy, *Basilarchia archippus archippus,* Decatur, Ill.

FIG. 67—The Florida viceroy, *Basilarchia archippus floridensis,* Miakka City, Fla., July 1900. Some from eastern Virginia are darker than this.

FIG. 68.—Left, the Olympian marble, *Zegris olympia,* under side, west of Cross Junction, Frederick Co., Va., April 24, 1938. Right, the Virginia white, *Pieris virginiensis,* under side, west of Cross Junction, Frederick Co., Va., April 24, 1938.

less commonly from the north. It is always a great thrill to get one of these lost wanderers, but actually they do not mean very much.

The regular, or more or less frequent, visitors, however, are of considerable importance. For if you are really to understand the butterflies of any region you must be able to distinguish the permanent residents from the visitors; and Virginia, with four faunal zones, with high mountain peaks offering favorable conditions for northern species, a broad coastal plain widely open to the south, and broad avenues coming in from the Mississippi valley, is most unusually tempting to visitors from all directions.

No less than six additions were made to the list of Virginia butterflies this year. Three of these were to have been expected, but three were wholly unexpected.

In the middle of June, in company with Mr. and Mrs. Ernest L. Bell, we found Dukes' skipper (*Atrytone dukesi*) (fig. 65), previously known only from Mobile, Ala., on Pocaty Creek, in Norfolk County. On the next day we took a southern monarch (*Danaus plexippus nigrippus*) (fig. 64), not recorded from the United States, in Surry County, and later, early in September, found others in eastern Princess Anne County. The third unexpected capture was the Florida viceroy (*Basilarchia archippus floridensis*) (fig. 67) not known from nearer than southern Alabama, which was common in eastern Princess Anne County early in September.

The most interesting of the expected additions to the list was the very rare early hairstreak (*Erora laeta*), of which Prof. Lorus J. Milne captured a specimen at Mountain Lake, Giles County. One day in the latter part of April along a roadside in Frederick County I captured a Virginia white (*Pieris virginiensis*) (fig. 68, right). In western Frederick County we found the Olympian marble (*Zegris olympia*) (fig. 68, left) rather common.

Somehow no account of Virginia butterflies seems quite complete without a mention of the magnificent diana fritillary (*Argynnis diana*). Much to our surprise, we found this more numerous in Surry County on the coastal plain than we have ever seen it elsewhere. Mrs. Barnes, whose garden we examined, told us that she had seen as many as 25 at one time about her butterfly-bush.

As in past years, we are under deep obligations to many of our friends who have generously furnished us with records of their captures and turned over to us specimens of unusual interest.

BIOLOGICAL RESEARCH ON THE SNOWFIELDS AND GLACIERS OF ALASKA, 1936

By ERSÈBET KOL [1]

Szegēd, Hungary

Many travelers in Alaska have reported seeing red snow, and it has long been known that this phenomenon was caused by the presence of minute plants that live only in permanent beds of ice and snow. No scientific study of these microorganisms had been made, however, and it was for the purpose of conducting such a research and comparing the cryovegetation (plants that grow on ice and snow) of America with that of Europe that I visited Alaska in the summer of 1936. Grateful acknowledgment is made to Dr. C. G. Abbot, Secretary of the Smithsonian Institution, for the grant which enabled me to undertake this work.

I left Seattle for Alaska at the beginning of July, going as far as Seward by boat and from there by train to Mount McKinley National Park, where I lived in Savage River Camp. Using this camp as a base, I visited the surrounding glaciers and snowfields that were within the radius of a day's journey on foot or horseback. On such excursions I was careful to make pH determinations of both snowfields and icefields. I also made microscopic examinations on the spot as frequently as possible and always brought back living material in thermos bottles to be worked on later in camp.

My first excursion was to the head of the Savage River. On the surrounding slopes grow beautiful Alpine poppies and other flowers, and the many snowfields in this region yielded such characteristic snow algae as *Chlamydomonas nivalis* and *Scotiella nivalis*. Because the surface was thickly covered with refuse and fragments from the slopes, however, the cryoplankton which elsewhere develops in such quantities as to color the surface was poorly represented.

The valley of the Savage River is very large, but at one end it branches off into many small, steep gorges through each of which

[1] Holder of the Fellowship Crusade International of the American Association of University Women for the academic year 1935-36. The Alaska work was done under a grant from the Smithsonian Institution. Although the field-work was done in 1936, the report was not received from the author until June 1938.—Editor.

Fig. 69.—Snowfield with very poor vegetation at the head of the Savage River.

Fig. 70.—Snowfield with red snow below Thompson Pass.

Fig. 71.—Surface of Kennicott Glacier.

Fig. 72.—The ice wall of Worthington Glacier.

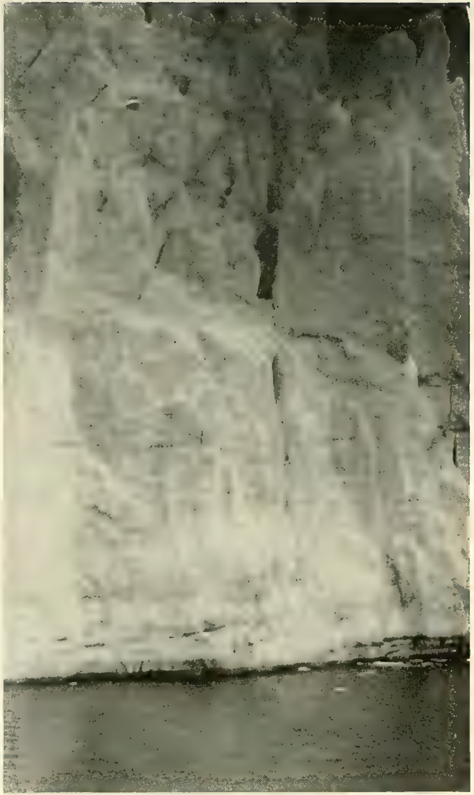

Fig. 73.—The great ice wall of Columbia Glacier.

Fig. 74.—The author standing on the surface of the Columbia Glacier covered with ice-bloom.

rushes a mountain stream. Where these streams join to form the river lies a marshy plain, and here I found very interesting fresh-water algae.

Another very interesting part of the Park is the Teklanika Valley. Into this large valley many glaciers descend, and these glaciers with their neighboring snowfields afford an excellent opportunity for the study of the effect of differing environment upon the ice and snow algae of the region. Such studies were continued throughout my Alaskan trip on the different mountain ranges visited. Throughout my stay in Mount McKinley National Park everything was done by the members of the Park Service, and particularly by H. J. Liek, the superintendent, to aid me in my work.

From the Park, I went through Fairbanks to reach the greatest glacier of the Wrangell Range, the Kennicott Glacier. In the neighborhood of this glacier is one of the greatest copper mines in Alaska, the management of which invited me to be their guest. The surface of Kennicott Glacier is of clean ice, and here I found the characteristic ice algae unmixed with the snow algae which had been present on the glaciers of Mount McKinley National Park. A difference is to be found, too, between the vegetation of the higher and the lower parts of the glaciers of both regions, the snow of the higher part of each sustaining a mixed growth of both ice and snow algae, while on the lower part only pure ice microorganisms are to be found.

From Kennicott I returned to the coast to continue my studies on the different snowfields and glaciers of the Chugach Range. When coming from Chitina I stopped at the Worthington Glacier from which I collected many ice algae, *Ancylonema*. My next center was the little port of Valdez lying at the foot of Valdez Glacier, from which it was easy to reach the snowfields and glaciers of the Chugach Range.

The most memorable incident of the Alaskan trip was perhaps my visit to Columbia Glacier. To reach the ice, I had to take a motor boat to a small bay beside the glacier and then proceed by row boat along the river that flowed into the bay from the glacier at that point. When I stepped on the ice, I saw for the first time a phenomenon of nature to be seen only on coastal glaciers. The surface of the ice was covered for miles and miles with light brownish-purple algal vegetation called ice-bloom. This effect is produced by immense quantities of minute plants called *Ancyclonema*, a characteristic plant of the permanent ice. It can never be found elsewhere, not even on permanent snow. *Ancyclonema* belongs to the green algae first found by Nordenskiöld on

FIG. 75.—Teklanika Glacier, Mount McKinley National Park.

FIG. 76.—Snowfields of Mount Robert above Juneau.

FIG. 77.—Ice wall of the Mendenhall Glacier.

the coast glaciers of Greenland. Since that time, this microorganism has been found in several different localities in Europe, and I have found it occasionally on the glaciers of the interior but never in sufficient quantities to form the ice-bloom of the coastal glaciers.

Here I had the opportunity of studying another striking phenomenon of the permanent snow regions of Alaska—colored snow, especially red snow. Above Valdez, around the Thompson Pass, the snowfields glitter with a reddish color in the beginning of August. The snow was red not only on the surface, but also to a depth of several inches and even in one place to a depth of 2 feet, caused by the presence of millions of tiny plants, *Chlamydomonas nivalis*. The snow on Thompson Pass looks as though it had been sprinkled with red pepper, differing in this respect from the red of other snowfields, which is usually a light raspberry red.

The life of the microorganisms is not yet precisely known. Heretofore it has been necessary to conduct investigations in the field, as these organisms could not be cultivated in laboratories, and field-work in the regions of permanent snow and ice is greatly handicapped by the difficulty of transporting the necessary apparatus. However, a high mountain laboratory has been built in Switzerland on the Jungfrau Pass, 11,382 feet high, which is very helpful to research on cryovegetation. It would be necessary to build many more such laboratories in the vicinity of permanent ice and snow in order to carry on continuous study of life under such extreme conditions.

After a fortnight's stay, I left Valdez by steamer for Juneau to continue my research in the Coast Ranges. The snowfields of the mountain above Juneau are very interesting biologically. Here for the first time I saw masses of tiny snow fleas. The surface of the snow was gray, and the fleas were piled up about half an inch deep and were rushing about like bees in the hive. The whole mass was of a deep gray-violet color.

I visited Mendenhall Glacier and found there quantities of the *Ancyclonema*, which I had also found on Valdez Glacier.

I left Juneau at the end of August and returned to Seattle, bringing with me for future study a large and interesting collection of snow algae from Alaska in small bottles preserved with formalin.

EXPLORING A CAVE IN SOUTHWESTERN TEXAS

By FRANK M. SETZLER

Head Curator, Department of Anthropology, U. S. National Museum

Through the generosity and anthropological interest of Laurence L. Wilson, the Smithsonian Institution was able to resume an archeological program in southwestern Texas begun in 1931. Previous explorations in the Chisos Mountains, around the city of Alpine, and near the mouth of the Pecos River had resulted in establishing a fairly complete outline of the prehistoric cave-dwellers, their handicraft and their simple form of existence. The fact that they lived a rather nomadic type of life, seemingly isolated from their more advanced and sedentary neighbors, and the relative narrowness of their skulls, presented a host of anthropological problems.

The writer, who had directed the previous excavations, left Washington April 1, 1938. Thanks to the cooperation of R. E. McDonald, United States Department of Agriculture, at San Antonio, Texas, a small truck was again put at his disposal, which contributed largely to the success of the expedition. After consultation with the late sheriff of Terrell County, Lee Cook, and Judge W. F. Boggess, of Del Rio, the M. H. Goode ranch (fig. 78) was selected as headquarters for initial reconnaissance. Situated in the extreme northeastern corner of Terrell County and only a few miles west of the Pecos River, it was ideally located.

Five memorable days were spent in the company of Mr. and Mrs. Goode and their son "Dunc," while most of the larger canyons and tributaries were tramped over in search of suitable sites for excavation. Caves were examined along the Pecos River, Independence Creek, Richland and Big Canyons, and their smaller tributaries.

In gratitude for the many personal favors extended by the owner of the ranch, the site selected (fig. 79) was officially designated as the "Goode Cave." It is located on the south side of Richland Canyon 1 mile west of the ranch house and 4 miles west of the Pecos River. The cave faces approximately 15 degrees north of west, overlooking two small box canyons.

After camp was established in a grove of cedar and persimmon trees (fig. 80) the first operation was to bisect the large mound of fire-cracked stones outside the overhang which was formed by the aborigines living in the cave. Besides the angular, fire-cracked stones averaging in size about 6 cubic inches, it contained small quantities of

Fig. 78.—Richland Canyon, as seen from the mouth of Goode Cave. Camp in the center foreground.

Fig. 79.—View of Goode Cave from floor of canyon. Note mound of stones in front of cave.

Fig. 80.—Our outdoor kitchen and dining room.

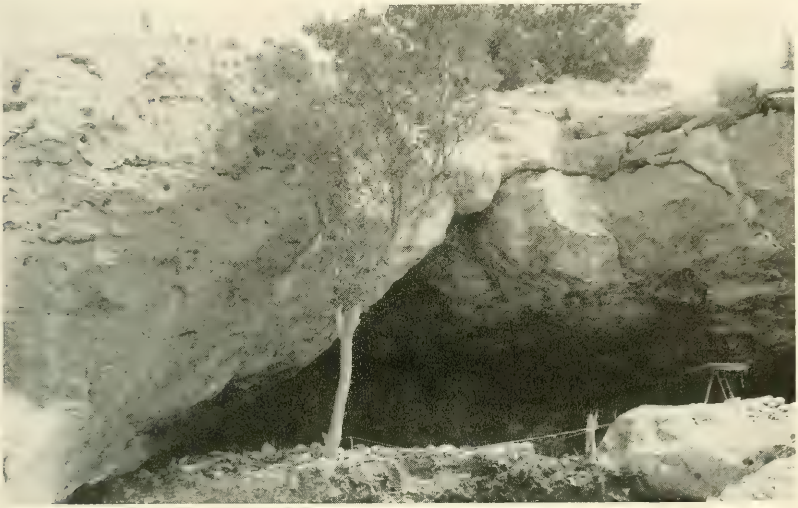

FIG. 81.—Mouth of Goode Cave.

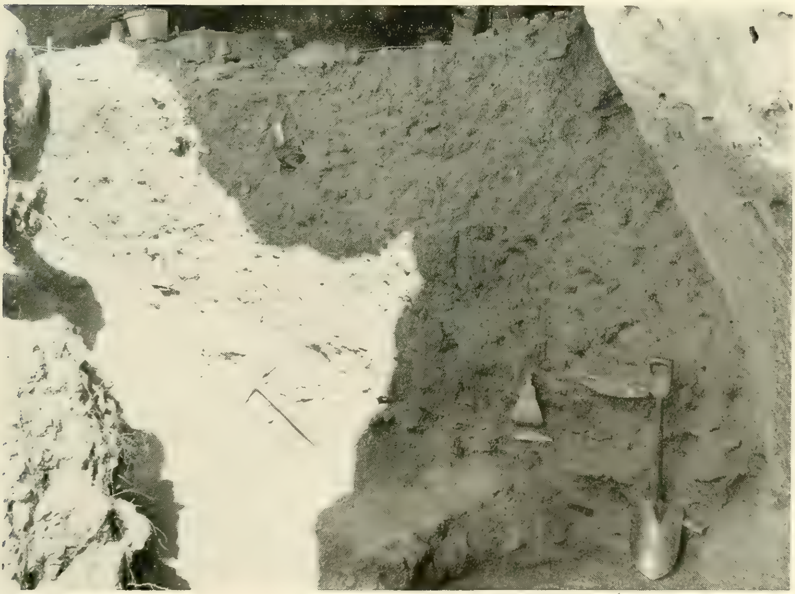

FIG. 82.—Nine feet of deposit above floor of Goode Cave.

sotol ashes, an occasional flint knife, broken arrowheads, and a few clam shells. The ashes were very fine and powdery, penetrating everything, especially our eyes, when the wind blew from the wrong direction.

Inside the cave (fig. 81) our trenches were dug down to the live rock. Large boulders—from the ceiling—had to be broken or worked around when too large. In the second 5-foot section we began to realize how deeply these deposits had accumulated (fig. 82). We were not only surprised at the depth of deposits, but amazed to find small natural alcoves at each side of the cave which were completely filled to the roof with occupational debris. One large rock had fallen from the ceiling during the time the cave was inhabited, and subsequently a large mortar hole had been ground into it. Near this hole we found an interesting roller type of pestle used no doubt for grinding seeds and perhaps corn, although no cobs were found.

Because of numerous sotol plants in the region, the cave may have served as a ceremonial center where large quantities of sotol stalks were roasted and the liquid, extracted from these roasted plants, permitted to ferment in order to supply a mildly alcoholic beverage. Limestones were probably used in the process of roasting, which accounted for the unusually large deposit. The small amount of animal and fish bones within the cave may indicate that the site was used only as a temporary habitation. The similarity in artifacts, the lack of any European objects, and the absence of pottery vessels lead to the assumption that the people were culturally related to, and lived contemporaneously with, the cave-dwellers farther south and west. No cave in West Texas seemed so suitable for burial purposes, yet not a single human had been buried within the cave. Nevertheless, the depth of the deposits as well as the tons of fire-cracked stones outside the mouth of the cave certainly indicate that the site was used by prehistoric man for many years.

During a short visit to Carlsbad, N. Mex., a study was made of the cave material from the Guadelupe Mountains collected by R. M. P. Burnet, who assisted me in the excavation of the Goode cave. After seeing a few examples of sandals and coiled baskets in the Anthropological Museum at the University of New Mexico, Albuquerque, the writer is convinced that the general Big Bend cave culture had a much wider distribution than heretofore conceded. This simple, non-pottery-making, seminomadic, prehistoric complex probably extends as far west and north as the central portion of New Mexico. Its exact relationship to the other cultural complexes in the general Southwest has yet to be clarified.

EXPLORATION IN THE ALEUTIAN AND THE COMMANDER ISLANDS

By ALEŠ HRDLIČKA

Curator, Division of Physical Anthropology, U. S. National Museum

With the 1938 expedition to the Aleutian and Commander Islands, ends the writer's tenth season of work in the Far Northwest. Begun in 1926 with a survey of the Yukon and a large part of the coasts, the explorations were gradually extended to the Kuskokwim and Nushagak Rivers, to the base and adjoining parts of the Peninsula, to Kodiak Island, and finally, since 1936, to the Aleutian chain and the Commander Islands.[1] Their still further extension into Siberia proved for the present unfeasible.

The 1938 journey, undertaken at first with five and later with three volunteer students, began on May 21 at Seattle and ended at the same port August 25. The students who accompanied the expedition throughout were Alan May, of Wenatchee, Wash., a third-year veteran of these trips, and William Laughlin and William Clemes, of Willamette University, Salem, Oreg.

The sea transportation was furnished throughout by the United States Coast Guard. The Service deserves great credit for their invaluable aid throughout these expeditions; without this generous aid the carrying out of the tasks would have been impossible.[2]

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[1] For preliminary reports of the trips see the "Explorations and Field-Work of the Smithsonian Institution," 1926 (1927) to date.

[2] Cordial thanks this year are especially due to Capt. L. C. Covell, Chief of Operations of the Coast Guard, Washington, D. C.; Capt. R. W. Dempwolf, Commander, and Capt. M. J. Ryan, Chief of Staff, of the Seattle Division; Capt. J. A. Alger, Commander of the Bering Sea Patrol; Capt. F. A. Zeussler of the *Northland,* and Capt. H. W. Stinchcomb of the *Ariadne;* to Capt. J. Trebes, Jr., of the *Shoshone;* together with their fine officers and crews. Thanks are further due to Mrs. Margaret Pedler and Mr. Pedler, of Unalaska, to Mrs. Mary Benson and Mr. Benson, teachers at Nikolski, Umnak, and to Gordon Jones, Superintendent of the Alaska Packers Co. Cannery at Uyak, who provided the expedition once more with packing material and boxes. A grateful acknowledgment for important aid rendered to us with our housing at the island of Amchitka is due to the United States Bureau of Fisheries and Mr. Christofer, their Bering Sea representative. We deeply appreciate the aid received from Mr. Oumansky, Counselor of the Soviet Embassy in Washington, and from the Soviet representatives, as well as many others, on the Commander Islands. Had it not been for the friendliness of everyone, the results realized on this and former expeditions could not have been attained.

Fig. 83.—Lower site, Constantine Harbor, Amchitka Island.

Fig. 84.—Stratified deposits, lower site, Amchitka Island.

FIG. 85.—An Aleut burial (contracted position), lower site, Amchitka Island.

FIG. 86.—"Calico deposits," hill site, Amchitka Island.

The main objects of the 1938 expedition were, first, to obtain further light on the existence and extension, in the Aleutian Islands, of the pre-Aleut stock, evidences of which were encountered in our excavations in 1936 and 1937; second, to determine definitely whether or not the Commander Islands have served as a part of a second, southern, Aleutian chain bridge for the coming of man from Asia; and third, to reexamine the burial caves found in 1936-37 and to search for several other reported caves of the same nature.

The first visit was to the rock shelters on Shiprock, in the Unalaska-Umnak Pass, where numerous skeletons and mummies were obtained on the last day of the trip of 1937. The mummy shelter was seen to have been exhausted by us, but a large broken slab, which was covered with dirt last year, had meanwhile been cleaned by rains, revealing several petroglyphs of a peculiar character. And a whale scapula, which originally covered one of the mummies, was found to have been decorated with broad parallel lines in red. Both these features are unique in our experience in these islands. A day's excavation in nearby shelters on the Rock yielded several Aleut skulls and skeletons, three stone lamps of the interesting flat variety found for the first time in 1937, and other objects.

The next visit was to Sviechnikov Harbor on the south shore of Amlia Island, where in 1937 human remains were found in several rock shelters. Two good days were spent here in reexamination of the shelters, exploration of a despoiled burial cave, and excavation in two sites located in the harbor.

The third point which it was possible to revisit was the little island of Ilak where we satisfied ourselves there were no burial caves other than the two we had examined the previous year.

The next stop was on the island of Amchitka. After a stormy night on the little *Ariadne* we were put off in Constantine Harbor, where there are a couple of small houses recently constructed by the Bureau of Fisheries and four native trapper dwellings, with an attractive little native church. There are no inhabitants on the island in summer. We found here two good sites, largely pre-Aleut, and had 3 weeks of assiduous excavation. This yielded, aside from a variety of cultural objects, several of the oblong-headed pre-Aleut skeletons, and, deep in the deposits, the first specimens found in these parts of the world of well-wrought deep stone pots and dishes.

From Amchitka in another storm we were taken back some hundreds of miles to the village of Nikolski, on the island of Umnak, where we were kindly given accommodation by the local teachers, Mr. and Mrs. Benson. A short distance south of the school, across a

FIG. 87.—The great pre-Aleut mound at Nikolski, Umnak Island.

FIG. 88.—Stratification and disturbance of deposits, great pre-Aleut mound, Umnak.

creek, is a hill 600 feet long, 250 feet broad, and 30 feet high, on the highest point of which, now marked by a stout Russian cross, stood, according to tradition, the first Russian chapel, and on which are now located two native houses and two semisubterranean dwellings. From this hill in 1937 we obtained three of the oblong-headed skeletons, and here, on the southeast side, we made in 1938 extensive and most fruitful excavations. These showed that the eastern main part of the knoll, if not all of it, was not a natural hill, as first supposed, but a great accumulation of human refuse. The maximum thickness of these layers on the south side, facing a lake, was found to be at least 20 feet, and, what proved even more important, the whole except the surface dated evidently from pre-Russian times and belonged to the oblong-skulled pre-Aleut people. The 3 weeks spent at work here proved fruitful in every particular. We recovered a whole series of skeletons, some of which rested below 8 feet of deposits; deep in the deposits were found many fragments of large well-wrought stone pots of various shapes, resembling those of Amchitka; and we recovered many bone and stone implements, among them several 13- to 14-inch beautifully chipped black basalt blades, a series of excellent large bone harpoon points, and several decorated ivory articles. Notwithstanding some local spoliation, the bulk of this site, and especially its lower and most important levels, remains intact, and the whole site deserves to be set aside as a scientific reservation.

From Umnak, late in July, we were taken by the United States Coast Guard vessel *Shoshone* to the Commander Islands. The visit to these islands occupied 5 days. The Russian authorities welcomed us, and the weather for once proved all that could be desired for our work. Accompanied by Lieutenant Lazarev, chief of the Border Guard in the islands, whose aid was very valuable, we were enabled to examine all the most likely locations for old settlements on both of the islands. We found a number of settlements, two of them—at Sarania and at Korabelni Bay—of considerable size, but on examination, some digging, and from inquiries among the oldest natives, all the sites without exception were found to date from the Russian period, and to be those of Aleuts brought there in the earlier part of the nineteenth century from the Aleutian Islands by the Russians. Not a trace of anything pre-Russian was seen or learned of on either Bering Island or Copper Island. Most of the places examined were so favorably located as to fine streams, lakes, and the seas, that, had there been any pre-Russian people on the islands they would certainly have settled there and left their remains; but there is definitely nothing of that nature.

FIG. 89.—Deep pre-Aleut burial, below an undisturbed stratum of alluvial sand, in the great mound of Umnak.

FIG. 90.—Deep pre-Aleut burial, below undisturbed alluvial layer of sand, in the great mound of Umnak.

It was necessary, therefore, to reach the conclusion that these islands had had no pre-Russian population, which sustains the previously expressed opinions on the subject, especially that of Dr. L. Stejneger, of the United States National Museum, who between 1882 and 1922 made several visits to the islands on biological quests. This result, though negative, is of substantial value. It removes beyond all conjecture any doubt on that moot point and establishes a solid fact which must be taken into account in all further work in these regions, and on the problem of the peopling of the Aleutian chain. It does not, however, do away with the probability of this chain having once received a direct native increment from Asia. This increment may have reached the chain from the Kuriles or from the north of Kamchatka. It did not, it is now certain, reach it from Kamchatka across the Commander Islands; this throws a reasonable doubt on any early peopling of even the Kamchatka Peninsula.

The whole Commander Islands' visit proved a rare treat. The islands are rich and highly interesting biologically, geologically, and in many other ways.

From the Commander Islands we returned to the Aleutians, and our first stop was at the Four-Mountain Islands. There, after a day of "full gale," we were enabled to revisit the burial caves on Kagamil and explore the rough, volcanic region in the vicinity. A number of additional skulls and specimens were recovered, but it was determined that no further burial caves exist in this part of the island.

The party was then able to spend another profitable day at Umnak; we visited the famed Boguslav Island, which was found to be not only a wonderful aviary, but also what now is doubtless the greatest breeding ground in Alaska of the sea-lions, hundreds of which, roaring, surrounded and followed the two boats in which we explored the place.

On August 15 we reached Dutch Harbor, Amoknak Island, and until the evening of the 17th excavated at our old site there, which since our departure in May had been badly vandalized. We left that same night on the *Shoshone* for Seattle, which was reached August 23.

The trip this year capped the Alaska work begun in 1926. The total results of these expeditions, while already obvious in the main, cannot be definitely presented before this year's collections are more fully examined. They will not solve all the problems, anthropological and archeological, of Alaska; but they will have paved with substantial facts a good part of a road which previously had been mostly but a trail of speculation.

EXCAVATING THE INDIAN VILLAGE OF PATAWOMEKE (POTOMAC)

By T. D. STEWART
Assistant Curator, Division of Physical Anthropology, U. S. National Museum

In describing his trip up the Potomac river in 1608 Capt. John Smith states that one of the Indian villages on the west shore, named Patawomeke, had 160 to 200 able men (upward of 1,000 inhabitants); it seems thus to have been the largest village along the river at the time. According to Smith it was at Patawomeke that Captain Argall abducted Pocahontas in 1612. We learn from this source also that in 1622 Captain Crashaw spent some time here trading. After this we find little information regarding the village. The date of its abandonment remains unknown.

Inspection of Smith's map of the Potomac River, on which Patawomeke appears as a king's residence, shows that this village was situated on the north side of what is now Potomac Creek, near Marlboro Point, Stafford County, Va. The Virginia land records indicate that the land constituting the "Potomac neck" was patented around the middle of the seventeenth century. About this time "Marlborough town," with a court house, came into existence less than a mile away from the Indian site. Thus it appears that the Indians rapidly gave way to such famous colonial families as the Brents, Fitzhughs, Masons, and Mercers.

For many years students of Indian history have visited Marlboro Point to obtain potsherds and other artifacts. Archeologically the old village site here is important because of its known contact with the Jamestown colonists. No extensive excavations were undertaken, however, until 1935, when the late William J. Graham, Presiding Judge of the United States Court of Customs and Patent Appeals, Washington, became interested. Working intermittently during the next 2 years, until his death on November 10, 1937, Judge Graham succeeded in locating three large ossuaries, two small burial pits, many post holes, trenches, etc. From the largest ossuary and one of the small burial pits Judge Graham recovered European objects: glass beads, iron, copper, and a silver cup made at the beginning of the seventeenth century. In another ossuary he found what is probably the largest human skull yet recorded.

Fig. 91.—Marlboro Point from 5,000 feet. Accokeek Creek (left) flows into Potomac Creek (foreground) which in turn flows into Potomac River (distance). Indian village of Patawomeke was located at the lower end of fence row in foreground. Colonial town of Marlborough was located on river side of point. (Photograph by U. S. Army Air Corps.)

Fig. 92.—The road to Marlborough from Stafford. One of the deep cuts bearing witness to the fact that this road has been in use since the latter part of the seventeenth century.

Fig. 93.—This bit of masonry is said to be all that remains above ground of the colonial town of Marlborough.

Fig. 94.—Post holes are one of the few remaining signs of the Indian village of Patawomeke.

Fig. 95.—The Late Judge William J. Graham shown removing human bones from an ossuary at Patawomeke.

Following Judge Graham's death, and in accord with his wishes, his collections from Patawomeke and their accompanying records were presented to the National Museum. Early in 1938, through the kindness of J. L. Pratt, of Fredericksburg, Va., permission was obtained to continue the investigation begun by Judge Graham. Since the writer had accompanied the latter on several occasions to aid in preserving skeletal remains, he was asked to take charge of the work. The sum allotted being rather small, it was decided to make the delimitation of the site the first objective.

During the summer of 1938 five trips were made to Patawomeke (60 miles from Washington) for the purpose of re-establishing Judge Graham's system of squares, checking the locations of his trenches and making a topographic map. Beginning September 8, 16 trips, 2 a week, were made to the site. During this period, with the aid of two local laborers and the trained assistance of Robert Ladd, of Washington, it was possible to remove 6,425 square feet of topsoil and examine the subsoil for signs of disturbance, such as post holes, pits, trenches, etc.

Unfortunately, the eastern part of the site was placed under cultivation during the fall. By the close of the season, however, we had obtained the outlines of what is probably the main part of the Indian site. Located on a 30-foot bluff just above a spring that is still in use, the village was surrounded by one or more circular stockades. What appears to have been the inner stockade had a diameter of about 175 feet. We were not able to trace as completely the outer concentric rows of post holes, but these may extend the diameter of the village to 280 feet or more. In this connection it may be recalled that some of John White's drawings of the period show Indian villages surrounded by circular stockades.

The post holes which now mark the village outline appear as round dark spots in the yellow subsoil. When a post was removed, or was burned or rotted, its place was soon taken by surface soil and camp debris. Today when we uncover these old post holes they are found to contain soft black humus, potsherds, charcoal, animal bones, shell, etc. Typical holes are 3 to 4 inches in diameter; they rarely penetrate the subsoil more than a foot.

Although this brief season's work has broadened considerably our knowledge of Patawomeke, many details still remain to be cleared up. For instance, the entrances to the stockade have not yet been identified; the locations of the dwellings and ceremonial structures, the manner of their construction, and the nature of their furnishings are yet to be ascertained.

ARCHEOLOGICAL RECONNAISSANCE IN SOUTH-EASTERN COLORADO

By WALDO R. WEDEL

Assistant Curator, Division of Archeology, U. S. National Museum

On August 14, following intensive excavations in western Missouri, the writer proceeded to Pueblo, Colo., to investigate caves reported to have disclosed traces of Indian occupancy. These reports, originating from cowboys and pipeline workers, were expectably vague, but it seemed possible that some of the shelters might yield evidences of geologically ancient man. About 2 weeks were devoted to reconnaissance in the Purgatoire and tributary canyons, Las Animas County, and to brief inspection of several open sites in Baca County. During this work I was accompanied by L. L. Wilson, retired mining engineer from Manila, P. I.; my assistant, M. F. Kivett; and at various times by local residents serving as guides. Among the latter, J. J. Breslin, of Higbee, was particularly helpful.

In marked contrast to the surrounding flat High Plains, the region immediately adjoining the Purgatoire is surprisingly rugged, with sandstone plateaus cut by deep canyons (fig. 96). Here and there below the ledges forming the canyon rim are small overhangs and natural shelters. Several of these within 6 or 7 miles of the Model camp of the Colorado Interstate Gas Company were visited. On the low ceiling of a small shelter some miles to the southwest were simple red pictographs. From another at the head of a branch canyon to the southeast came the fragmentary skeleton of a young female accompanied by plain and incised tubular bone beads. In the shallow dirt floor were a few flints and cord-roughened, grit-tempered potsherds. Said to be identical with sherds previously found in other local shelters, these apparently were related to certain "Plains Mississippi" wares. A third and much larger overhang on the right rim of Purgatoire canyon about 3 miles east of the Model pumping station yielded corncobs, wooden foreshafts, nocked arrow fragments, painted and sinew- or grass-wrapped sticks, pumpkin seeds, a bone awl, and other remains. All finds were within 8 inches of the surface; otherwise, the fill, which in places reached 3 feet, was culturally barren. Ledges in both the larger caves bore grooves and circular basins from food-grinding activities. Probably these can be ascribed to Indians who perhaps farmed nearby alluvial flats rather than to Mexicans.

FIG. 96.—Canyon of the Purgatoire from large rock shelter under east rim; about 25 miles east of Model, Colo.

FIG. 97.—Site of cave near Dougherty ranch house, Chacuaco canyon

FIG. 98.—Sunset on the Purgatoire. Spanish Peaks, 60 miles distant, on skyline at left.

FIG. 99.—Farmstead and country road at Baca County, Colo. Blown fields beyond the buildings have yielded Folsom points.

Three days were spent in the Chacuaco-Plum creek canyons farther east. On a lofty butte near the Bob Dougherty ranch house a small cave was cleaned out (fig. 97), yielding bone and shell disk beads, small projectile points, mullers, and similar camp debris. Near the upper end of the "Red Rock" exposure in Plum canyon another small shelter was tested. Here, too, were seen crudely laid up walls atop a small steep butte on whose lower slopes were scattered a dozen or more crude boulder circles 8 to 15 feet across and up to 3 feet high. Arrowheads and chipped flints were plentiful nearby but no pottery was found. Similar structures are said to be fairly common on the less accessible elevations of the region, and locally they are known as "Indian forts." From our limited examination, an Indian provenience seems more likely than the suggestion that they were left by Mexican sheepherders.

In Baca County, heart of the "dust bowl," we visited three open camp sites about 20 miles south of Pritchett. From badly blown fields (fig. 99) local collectors here claim to have taken Folsom and Yuma artifacts and, in one instance, remains of an extinct camel. Miscellaneous flints, scrapers, knives, projectile points, and hammerstones were gathered by us, but nothing of demonstrably ancient date. On one site were small scattered piles of burnt and cracked stones; others showed black soil areas suggestive of hearths. All sites examined were near dry watercourses or on old dried-up shallow lake beds.

From Pritchett our party proceeded to Kenton, Okla., thence westward up the picturesque Dry Cimarron and over to Trinidad, en route making a fruitless side trip into Travaseer canyon east of Folsom, N. Mex. From Trinidad, where local collections of Folsom artifacts were examined, we headed east via Springfield to Lamar and Pueblo.

In general it was found that (1) local rock shelters are mostly small and shallow, giving little promise of producing cultural remains as old as Folsom or Yuma are usually believed to be; (2) local collectors unanimously aver that such ancient remains are exceedingly rare in the cave and canyon country, though many occur in the sandy blown-out region from Baca County north; (3) occasional rock shelters do contain cultural vestiges which, while apparently not geologically ancient, certainly merit careful scientific scrutiny before untrained excavators destroy the record.

EXCAVATIONS IN PLATTE COUNTY, MISSOURI

By WALDO R. WEDEL

Assistant Curator, Division of Archeology, U. S. National Museum

Scattered along the timbered bluffs of the Missouri River from its mouth to a point near St. Joseph, Mo., are groups of small mounds in which excavation has revealed stone enclosures containing burials. Their age, origin, and tribal identity have long resisted interpretation, though from the uniformity of construction it has been thought by some that they were left by a single people moving up or down the valley. Below the mouth of the Osage River, such pottery and other materials as have been found in the chambers suggest affinities with remains usually termed "Woodland" in the eastern United States. Farther west there is less internal evidence, so that assignment of those in the Kansas City region to a given archeological horizon has been well-nigh impossible. During the summer of 1937, however, my investigations in southern Platte County had disclosed village sites with artifacts evidently related to the Hopewellian complex of the upper Mississippi drainage; concurrently amateurs nearby reported the finding of similar pottery in a stone enclosure. With renewed hopes that some of the mystery still surrounding these structures might finally be dispelled, I resumed excavations in May along the north bank of the Missouri between Parkville and Farley.

Nine enclosures were examined; all had been dug into previously and two were so hopelessly plundered as to give no reliable information. From the others it was established that the chambers vary from 6 to about 9 feet across, square to oval in outline, and range from 2 to nearly 4 feet deep. They consist of a carefully laid up mortarless wall of horizontal slabs, against which other large flat rocks were leaned. The area thus covered was about 15 feet in diameter. Somewhere in the south half the wall is ordinarily broken by a narrow entrance passage. It is not certain whether the chamber was roofed, but if not it is difficult to understand the reason for a passage. Two mounds yielded the dismembered skeletons of perhaps a dozen individuals, apparently of a medium-statured long-headed people. Although less than half the bones were actually burned or cremated, fire evidently played an important though undetermined role in the mortuary complex. Artifacts were very rare and inconclusive, but it was noted that shell-tempered smooth and incised pottery occurred in por-

Fig. 100.—Ridge bearing stone enclosures; Missouri River in background.

Fig. 101.—Cross-section of burial enclosure, Nolan mound C.

Fig. 102.—Nolan mound C, partially excavated. Note square burial chamber opening toward south; also large leaning slabs and outer sheath of earth and stones.

FIG. 103.—Prehistoric burials near Farley, Mo.

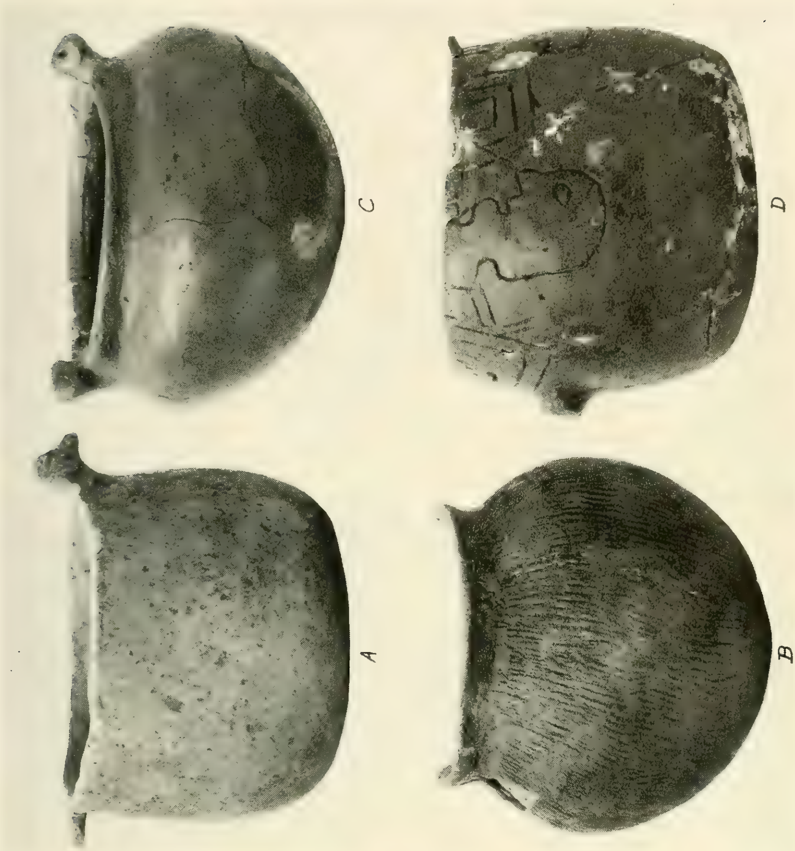

FIG. 104.—Pottery from Platte County sites. A, from burial ground near Farley; B, from earth mound near Waldron; C and D, from large mound near Smithville.

tions of the structures which had been disturbed in pre-white days. In five mounds which were entirely excavated we found that earth had been piled against the large leaning slabs and that a mantle of smaller slabs had then been laid over the entire (?) mound to cover an area 25 or 30 feet across (fig. 102). Without detailing the evidence, I am inclined to attribute the earth fill and outer slab sheathing to a later people than those who erected the original vault, perhaps to the same group which left shell-tempered pottery in the tombs. Although direct proof is mostly lacking, it seems likely, too, that the original structures in this vicinity were built by a people with Hopewellian affinities who were probably among the earliest potters and farmers in the eastern plains.

Near Farley, on the right bank of the Platte River, a prehistoric village and cemetery with different cultural connections was explored. Here the natives dwelt in earth-covered partly subterranean structures whose roofs were borne by four central posts. Shell-tempered pottery, often with incised lines, was abundant. Small modeled human heads and animal effigies occur on some vessels. Low recurved rims, angular to rounding shoulders, dippers, water bottles, and flat-bottomed vertical-walled bowls are other traits. Present also are small notched and unnotched points, scrapers, knives, drills, paired sandstone shaft buffers, the polished adz or gouge, effigy pipes, fine-grained sandstone ornaments, bone awls, socketed antler cylinders (handles?), deer jaw sinew stretchers, longitudinally pierced deer phalanges for cup-and-pin game, shell hoes, twisted cordage, maize, beans, pumpkin and sunflower seeds, and a few animal bones. In the nearby cemetery were more than 80 primary extended (fig. 103), bundle, and flexed burials, apparently of a short broad-headed population. Accompanying artifacts were scarce, but several restorable and one complete pot conclusively link the burials with the village. Near Smithville, a few miles up the Little Platte, similar vessels have been found recently by amateurs in a large earth mound, apparently with flexed mat-wrapped burials. Pottery (fig. 104) generally indicates close relationships to that found on certain so-called Middle Mississippi sites in southern Illinois and elsewhere. Though occasional trade pieces of this type have been coming to light even farther up the Missouri, no communities have heretofore been reported this far west.

Gratefully acknowledged is the cooperation of property owners during the past two seasons in Platte County, and invaluable assistance given by J. M. Shippee and other local enthusiasts.

FURTHER NOTES ON THE ROUTE OF DE SOTO

By JOHN R. SWANTON
Ethnologist, Bureau of American Ethnology

During the greater part of the month of October and the first half of November, 1938, I continued reconnaissance work in the interest of the United States De Soto Expedition Commission. I left Washington by automobile on October 3 with my son as driver and on the way south made another visit to Towns Hill near Walhalla, S. C., which I regard as the site of the Cheraw town visited by the Spaniards in 1540, and examined the lower end of the old Winding Stair Trail. The next stop was at Arlington, Ga., where Mrs. Wm. E. Bostwick, Jr., assisted by a group of girl scouts, has been trying to identify land-marks on that part of De Soto's route which passed through Decatur, Miller, Baker, and Early Counties. Under her guidance a visit was made to a spring at the head of Alligator Creek in Baker County, which may be the White Spring where De Soto's army passed the night of March 17-18. It is in competition for that honor with Holyhead Spring, some miles to the west.

From there we went to Tallahassee via Bainbridge, stopping at Milford to photograph the Ichawaynochaway River, believed to be the River of Toa of the Spaniards. At Tallahassee I had the pleasure of meeting and consulting with Dr. Herman Gunter, the State Geologist, and with J. Clarence Simpson, who is well acquainted with Indian remains in the northwestern part of the State. Mr. Simpson accompanied me to some neighboring sites including that of San Luis Mission, the Lake Jackson mound group, and sites occupied by the Apalachee Indians in the direction of the Gulf.

Going on south from Tallahassee, we stopped first to examine Aucilla River, former boundary of the Apalachee tribe toward the southeast, on the banks of which these Indians put up a stout resistance to their Spanish adversaries in the fall of 1539. We then proceeded as far as the Withlacoochee and followed the road along the west side which must lie very near the trail followed by De Soto on leaving Tampa Bay. On the way back a brief stop was made at Ocala and a somewhat longer one at Lake Butler, the county seat of Union County. The Narratives would indicate a considerable Indian population here, but few signs of it were discovered. On the way back to Tallahassee a stop was made at Madison and several Indian sites

Fig. 105.—Looking down on ford on old Winding Stair Trail, S. C., believed to have been used by De Soto in 1540.

Fig. 106.—Looking across White River at St. Charles Ferry, Ark., believed to be the place where De Soto crossed the river in 1541.

FIG. 107.—The Withlacoochee from bridge on State Route 74, Florida, not far from the place where it was crossed by De Soto in 1539.

FIG. 108.—Mouth of Boeuf River from launch, where it falls into the Ouachita River, La., supposed scene of De Soto's wanderings in 1542.

visited under the guidance of Mr. Carlton Smith. On returning to Tallahassee another conference was had with Dr. Gunter and Mr. Simpson, and we then crossed the State of Alabama to Aberdeen, Miss., merely making a stop at Tuscaloosa to call upon the Alabama member of the Commission, Dr. Walter B. Jones.

At Aberdeen I was met by Col. John R. Fordyce, of Little Rock, Ark., member of the Commission from that State, and was driven by him to various points of interest. In company with Dr. W. A. Evans, of Aberdeen, we made a further examination of the territory along the Tombigbee and visited a town site in Chickasaw County which is possibly that in which De Soto spent the winter of 1540-41, though it is a trifle far south. From this place we went to Helena, Ark., via Clarksdale and spent 2 days visiting sites along Crowley's Ridge believed to have been the location of the Province of Casqui in De Soto's day. On the way to Little Rock we stopped at some points on White River where trails are known to have crossed, because it is evident that the Spaniards used one of these in the summer of 1541 on their way toward the south.

At Little Rock I was the guest of Colonel and Mrs. Fordyce. Visits were made to the Menard Mounds east of Arkansas Post, possibly the site of the town of Quiguate, and the valley of the Little Missouri by which the Spaniards probably sought an exit to the south after leaving the Tula province at Caddo Gap.

On October 26, Colonel Fordyce and I joined Miss Caroline Dormon, the Louisiana member of the Commission, and her sister at Jonesville, and we spent 2 days exploring the Ouachita and Tensas Rivers in launches kindly put at our service by Brig. Gen. Harley B. Ferguson, president of the Mississippi River Commission. Although the region which the Spaniards visited in the neighborhood of these rivers is plainly indicated, their exact movements are difficult to trace.

A few days were taken up with a visit to Baton Rouge to consult with the geologists of Louisiana State University, Drs. Russell, Fisk, and Huner, and the archeologist, James A. Ford, regarding the late geological history of the lower Mississippi valley and the relation of the archeological remains to it. This conference proved to be of the utmost value. Mr. Ford brought me back to Alexandria, and on the way gave me a chance to examine the Coles Creek site near Marksville which is being excavated under Mr. Ford's direction under a large grant from the WPA.

ON THE TRAIL OF ANCIENT HUNTERS IN THE WESTERN UNITED STATES AND CANADA

By FRANK H. H. ROBERTS, JR.
Archeologist, Bureau of American Ethnology

Search for further information on Folsom Man, the aboriginal nomad who hunted big game on the western plains during the closing days of the Glacial Period, was continued throughout the summer of 1938. Excavations at the Lindenmeier site in northern Colorado, where previous investigations had revealed the remains of a camp once occupied by that early New World inhabitant, comprised a major part of the season's work. After the termination of the digging the writer visited sites in Nebraska, Wyoming, and Saskatchewan, Canada, where local collectors have found implements indicative of the Folsom or some presumably associated complex.

When the Bureau of American Ethnology-Smithsonian Institution Expedition had established camp at the Lindenmeier site (fig. 109), activities were resumed where the excavating was stopped at the end of the 1937 season and were continued until six additional parts of the area had been examined. Despite an unusually stormy summer (fig. 110), and the handicap of numerous heavy rains, some of cloudburst proportions, a total of 3,500 square feet of the original surface of occupation was uncovered. Removal of the overburden (fig. 111), ranging from 3 to 8 feet in depth, exposed various concentrations of stone implements, cut and split animal bones (figs. 112, 113, 114), the remains of several hearths, and places where stone chippers had fashioned different kinds of tools from nodules gathered from the surrounding countryside. The collection of specimens obtained includes several new types of knives and scrapers in addition to typically fluted points and other implements similar to those found in former years. There is also a series of bone fragments bearing incised lines, indicating that the people had a simple form of geometric art, and there are bits of polished bone suggesting that tools were made from that substance as well as from stone.

The hearths were not well-made fire pits. They were either simple depressions in the earth or merely places where fires had been kindled on the surface. Most of the animal bones are from bison, the extinct *taylori,* although there are some from deer and antelope of as yet undetermined species and from smaller mammals such as the fox

Fig. 109.—Expedition camp at the Lindenmeier Site. (Photograph by Charles R. Scoggin.)

Fig. 110.—Electrical storms were frequent during summer of 1938. This picture was taken at 11:30 P. M. (Photograph by Charles R. Scoggin.)

FIG. 111.—The overburden being removed, layer by layer, from sections containing bone deposits. (Photograph by Charles R. Scoggin.)

FIG. 112.—Plotting and photographing bones and stone implements before their removal. (Photograph by Charles R. Scoggin.)

and jackrabbit. At some distance from the main diggings a portion of a mammoth tusk, together with some small splinters from split bones and some pieces of charcoal, was found in the same horizon as the other material. There were no implements or stone flakes in association with the tusk, and as a consequence it cannot be stated definitely that the creature was killed by the people who hunted the bison and other animals. There was nothing to indicate that the tusk and bone splinters were rolled or washed into the location where they were found. The edges are sharp and show no marks of abrasion. Evidence from other places has demonstrated that Folsom Man preyed on the mammoth, and it is possible that the dwellers at the Lindenmeier camp did likewise. The tusk at least shows that mammoth were in the vicinity at approximately the same time as the Folsom men, an occurrence previously suspected but for which there was no proof. One of the main objectives of the expedition, the recovery of a human skeleton, was not attained. Thus far not one bone attributable to man has come from the excavations, and the physical characteristics of the people are still unknown.

The sites visited in Nebraska are located in the southwestern corner of the State in Chase and Dundy Counties. All those seen by the writer are "blow-outs," places where constant action by strong winds has swept away areas of surface soil exposing the underlying stratum of harder, claylike earth. The artifacts—points, scrapers, knives—are found lying on these exposed surfaces. Folsom type points occurring there are quite like those from the Lindenmeier site. In addition there are numerous long, narrow, thick-bodied points with a triangular or oval cross-section that have been given the name Yuma. The latter are a complicating factor in that their meaning is not clear. They may belong to the Folsom series or be an indication of another complex. They are found in association with Folsom material in some localities, but in others they are not. Only a very small percent of the points from the Lindenmeier site can be regarded as having Yuma characteristics, and the majority of these come from higher levels. Hence for that district they can be regarded, at most, as demonstrating a very late contemporaneity between the two forms. Information from the Nebraska sites contributes little toward answering the relationship question because no digging was done.

On the strength of information from D. B. Hilton, of Sundance, Wyo., the writer went to that place to investigate the finding of two Yuma type points and a series of five bison skulls. The discoveries came as the result of work on an earth dam across Sundance Creek just east of the town. The points were at the bottom of the soil zone

FIG. 113.—Chopped and split bones in place before removal. Measuring stick is 2 feet long. (Photograph by author.)

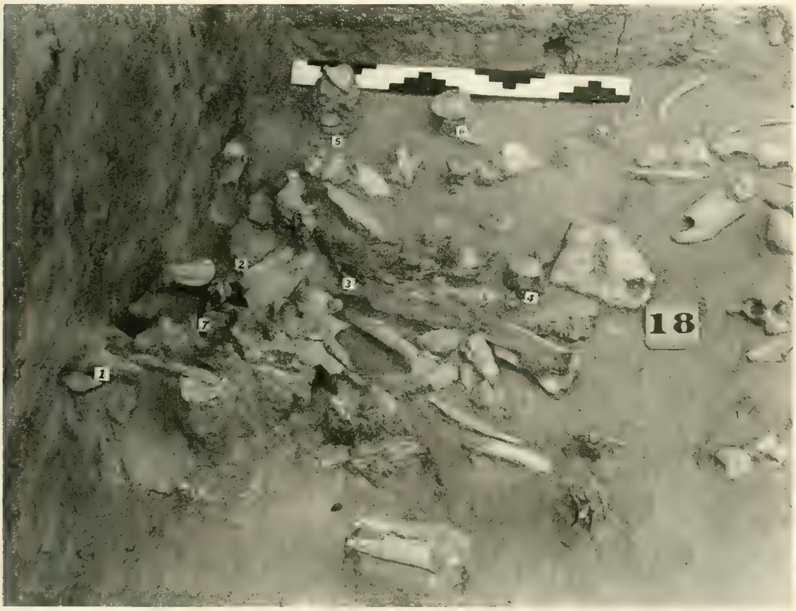

FIG. 114.—Bones and stone tools in situ. Small numbers indicate location of implements. (Photograph by author.)

that forms the present floor of the valley. When first seen they were protruding from the bank of the stream 2 feet below the present surface and several feet above the water line (fig. 115). They were just above a bed of hard red clay that forms the substratum for the area. The bison skulls were scooped out by a grader gathering dirt to be used on the dam. They were together, forming a single group, and no other bones accompanied them. They came from the same horizon as the points, and although conclusions cannot be formed from material not actually in situ, it seems reasonably certain that they belong to the same period of deposition as that represented by the points. The skulls are definitely those of modern buffalo. Numerous flakes and chips of stone, pieces of charcoal, and traces of ashes occur at the same level. These suggest a surface of occupation and the possibility of the remains of a camp nearby.

There are several places in the vicinity of Sundance where stone artifacts are found on the surface, and many local residents have sizeable collections gathered from them. All of these were seen and studied and a dozen more Yuma points, either complete or represented by easily identifiable fragments, noted. There were no points or fragments of the Folsom type. The collections also contain many examples of the barbed arrowheads so widely used by the Plains Indians, as well as knives and scrapers, none of which exhibit characteristics of the Folsom tools of similar form and purpose. One group of points from a single location on a hillside a short distance from Sundance is of particular interest because all are of the same type as an example obtained from a stratum lying 2 feet above the Folsom layer at the Lindenmeier site. They apparently are older than the ubiquitous barbed arrowhead, but are much later than Folsom. Their occurrence with Yuma specimens indicates that in the Sundance area, at least, there was a much later survival for the Yuma than for the Folsom.

In the vicinity of Mortlach, Saskatchewan, are a number of "blow-outs" that developed as a concomitant of the droughts and high winds prevailing there in recent years. They are much like the "blow-outs" in the plains districts farther south in the United States. At various places the completely dried out top soil has been swept from the surfaces of fields, exposing a hard, grayish-black, sandy-clay deposit. Animal bones and stone implements are weathering out of this substratum (fig. 116), and large collections of points and other tools have been gathered by local people interested in Indian artifacts. The existence of these sites was called to the writer's attention in the autumn of 1937 by Kenneth F. Jones, of Mortlach. Letters and pictures sent by Mr. Jones indicated that he had found portions of Folsom points,

FIG. 115.—Bank where Yuma points were found near Sundance, Wyo. Location was at left of standing figure. (Photograph by author.)

FIG. 116.—Exposed surface in "blowout" near Mortlach, Saskatchewan. Light spots in foreground in front of standing figure are bones weathering out of the sandy-clay. (Photograph by author.)

numerous examples of the Yuma, and other implements suggestive of an older horizon than that of the recent Indians.

Mr. Jones took the writer to the places where he obtained the various specimens comprising his extensive collection. Most of them lie to the north of Mortlach, but some are to the west and the south. The district is typically plains land, mainly flat, although there is some slightly rolling terrain. The area north of the town, where the best artifacts occur, suggests the former existence of a series of shallow lakes or ponds, marshes, and bogs extending in a northwest to southeast direction. These no doubt attracted game animals and their shores would provide good camping places for the people hunting them, which probably accounts for the presence of the extensive remains of both. Most of the bones scattered over the surface and weathering out of the bottoms of the "blow-out" basins appear to be from bison, although other smaller forms are present. Many of the bison bones correspond in size to those from modern buffalo and may represent that animal. Others are larger and may possibly be from one of the extinct forms. To settle this question, it would be necessary to obtain by excavation those portions of skeletons on which species identification is based. Only a few points and fragments of Folsom type, five or six at most, have been found in this region, but there are literally hundreds of the Yuma and barbed forms. Most of the specimens have been picked up from the surface, but a few have been scratched out of the top of the exposed substratum.

The constant association between Yuma and barbed types should not be stressed too strongly at this time; the latter could have been in higher levels and dropped down to the top of the hard layer as the overlying soil was blown away. Yet the writer dug one barbed example from the substratum and found another partially embedded in it. On the other hand, many Yuma pieces lying loose on the surface have been picked up by collectors. In view of this, coupled with the indications at Sundance, it seems that a somewhat later horizon is indicated than is the case where points are predominantly of the Folsom type. The Mortlach sites are important, however, because of their size and the amount of material present in them and because there is the possibility of finding places along the edges of the "blow-outs" where excavation would reveal stratified deposits and produce evidence on the sequence of the different forms of implements. They extend the range of Folsom and Yuma artifacts well toward the north along the supposed avenue of migration for peoples coming over from Asia, and investigations in the Mortlach district may furnish much needed data on the Yuma problem.

ANTHROPOLOGICAL RECONNAISSANCE IN SOUTH AMERICA

By JULIAN H. STEWARD
Associate Anthropologist, Bureau of American Ethnology

En route to Ecuador and Peru to spend several months during the summer of 1938 in anthropological reconnaissance, a visit was made to the picturesque ruins of Old Panama (fig. 117), a few miles south of modern Panama City. Founded in 1519 and sacked by Morgan, the English pirate, in 1671, this large town had flourished and passed into history before the sites of most cities of the United States had been visited by white men.

Surprising and gratifying results came from this visit to Old Panama. It was found that the site has archeological importance as well as historical appeal. During the century and a half that the city had been occupied, refuse such as accumulates around any site inhabited by people had been piling up on the ground. Broken and discarded tiles, bits of pottery, bones, and many other objects were scattered through the earth. After the town was abandoned, the Pacific ocean began to encroach upon part of the refuse, eating it away and leaving a vertical face or cliff some 6 to 8 feet high. In the cross-section thus exposed, many fragments of unmistakably aboriginal Indian pottery were abundant at and near the bottom of the refuse but disappeared toward the top. The archeological story was plain. When the town was founded, Indians were amongst its population and at first made their own native style of pottery. After a generation or two, however, they learned to make glazed pots of the Spanish style and forsook their own ware.

Though not spectacular, this Indian pottery has great importance for archeology. It is one of the oldest pottery types of known date in Panama and will serve, therefore, to date strictly Indian sites in which it is found. It will also provide an important datum point for determining the sequence of Indian pottery styles in the region of Panama.

The trip was resumed by boat to Guayaquil and thence by train to Quito, the beautiful capital of Ecuador situated at 9,500 feet in the Andes. Subsequently, a visit was made to Cuzco located at over 11,000 feet in the Peruvian highland. In both nations, the bulk of the moun-

FIG. 117.—The ruins of Old Panama, built in 1519 and the oldest European city on the American mainland, cover a hidden story of archeology.

FIG. 118.—Llamas, well adapted to high altitudes, graze at 14,000 feet in the Peruvian Andes. Though only 14 degrees south of the Equator, large glaciers cap the 18,000-foot peaks in the background.

FIG. 119.—Musicians and bearers of fireworks lead a religious procession through the Ecuadorian highland village of Píllaro.

FIG. 120.—Crumbling adobe walls of the ghost city of Cajamarquilla, believed to have been built for the dead and not for the living, cover a square mile. This prehistoric site is on the Peruvian coast near Lima.

tain population is Indian. These people are true highlanders, for many hundred thousand live above 10,000 feet altitude, and villages may even be encountered at more than 14,500 feet—higher than the highest point in the United States. But the Indians seem well adapted to the thin mountain air which causes great discomfort to lowland-born white men.

The Indians of the Andes speak Quechua and once shared a high aboriginal civilization, most commonly known as Inca after its ruling family of late prehistoric times. Though many European customs have been adopted by these Indians, four centuries of contact with the Spanish have not served to eradicate features that flourished long before Pizarro's conquest in 1532. Such important aboriginal products as potatoes and corn are grown along with wheat and other cereals of European origin. Llamas continue to outnumber other beasts in the high altitudes to which they are suited (fig. 118). The Indians still weave with remarkable skill, especially in Peru, where, in pre-Columbian epochs, some of the world's finest textiles were produced. The woven poncho, often brightly colored according to local styles, continues to be the favorite garment, and native woven sandals are the main footgear—though pieces cut from old tires now threaten the popularity of the latter.

Should one visit an Andean village on the day of the patron saint or of some other religious fiesta—and these are frequent, as the entire population has embraced the Catholic religion—he would find the Indians devoting themselves with boundless enthusiasm to the festivities. The main out-of-door event is a colorful and often noisy procession. The processions are somewhat stereotyped (fig. 119). The padre leads the parade, perhaps on horseback. Next come the musicians, consisting of a fife and drum corps, followed by men bearing effigies of chairs, automobiles, ships, and various other objects sketchily constructed of bamboo. As the procession strolls through the narrow streets and several times around the plaza, on which the church invariably fronts and where the spectators have gathered, home-made sky-rockets affixed to the bamboo effigies are shot off from time to time, punctuating the music and delighting the crowd.

Other assemblies are held weekly or monthly when the people of each district gather to exchange produce and every conceivable variety of object in the market.

Visits were also made to many of the archeological sites of Peru. These monumental aboriginal works are even more impressive than the incomparable specimens of pottery, textiles, and metals which have

FIG. 121.—Sacsahuaman, built on a hill overlooking Cuzco, Peru, is a splendid example of megalithic construction. Though commonly called a "fort," these walls, a mile in circumference, were probably a religious structure.

FIG. 122.—Many modern buildings of Cuzco incorporate prehistoric masonry. The dark portion of the wall is the Inca Sun Temple, over which was built the Convento de Santo Domingo. This room is alleged to have been nearly filled with gold to ransom the Inca from Pizarro.

been dug from them and are exhibited in museums in all parts of the world. Archeology as well as historical documents left by the conquistadores evince an extraordinarily great and powerful native population. The ancient cities, which are built of adobe on the coast and are so numerous as to be local commonplaces, are many times larger than those of any North American Indians, their tumbled walls often covering scores of acres. The rooms, enclosures and mounds of Cajamarquilla, for example, a small portion of which appears in figure 120, occupy a square mile. Cajamarquilla is not only astonishing for its magnitude but has the peculiar interest, according to some local authorities, of having been built for the dead, not the living. The deceased were elaborately interred in the floor of each room.

Highland construction was primarily of stone, and many of the sites are renowned for the size of the building blocks and the skill with which they were fitted (fig. 121). Modern Cuzco, which prior to the conquest was long a center of Inca and pre-Inca civilization, has today scarcely a building the walls of which do not include the masonry of some prehistoric period. The Convento de Santo Domingo, for example (fig. 122), has incorporated the complete Inca Sun Temple, famous in history for allegedly having been filled two-thirds full with gold as the ransom demanded by Pizarro for the release of the Inca whom he had treacherously captured.

No less interesting than the ruins are the evidences of prehistoric agriculture. In these days of discussion and controversy about such agrarian matters as dust bowls and marginal land, it is astonishing to view the extensive land-utilization of ancient Peru. The pressure of that huge population which had made possible the construction of cities, temples, and mounds, and which is reckoned to have surpassed the present population in size, required utilization of land which today would be considered less than submarginal. Miles of steep and arid mountainsides were laboriously terraced and water carried for leagues in aqueducts to provide a few extra acres of arable land.

Thanks must be extended to innumerable officials and scientists of both Ecuador and Peru and to many other friends for their kindness and helpfulness on this trip.

SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1939

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PREFACE

This pamphlet is intended as a preliminary announcement of the results of the year's field expeditions. The scientific results will be presented in technical form in the various other series published by the Institution.

All the work of the Smithsonian Institution is directed toward the "increase and diffusion of knowledge." In certain of the branches of science in which the Institution has been particularly active—geology, biology, and anthropology—field work plays an important part by furnishing additional collections for laboratory study and by giving opportunity for first-hand observations on the ground, so essential in the prosecution of these sciences.

The photographs presented herein were taken for the most part by the authors of the various articles.

W. P. True, *Editor.*

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QUEST FOR GEMS AND MINERALS IN MEXICO

By W. F. FOSHAG
Curator, Division of Mineralogy and Petrology
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In continuation of previous work in the mining districts and mineral localities of Mexico, I visited some new localities and revisited some old ones where desirable material had been reported. It was planned to visit, by car, a number of smaller mining districts, remote from the railroad lines and main highways, which gave promise of yielding unusual material. Owing to the condition of the roads and the state of the mining industry of Mexico, however, my program could be carried out only in part, and more time was spent at accessible localities.

Among the places visited was Diente, a small district lying in a rugged range of limestone mountains that extend from Monterrey to the valley of Saltillo. It is chiefly interesting because of the geologic structure of the rocks that contain the lead-zinc ores. A similar occurrence of lead-zinc ores is found at Higueras, near Saltillo. Mining operations at this place have been reduced to the production of iron oxide ores for fluxing.

From Saltillo, I went to Ojuela, near Mapimi, in the state of Durango, a famous old mining district now in its last stage of exploitation. I had visited this mine in 1926, when it was in fullest operation, but the active mining was confined to the lower sulfide ore zones (now under several hundred feet of water). The reopening of the upper oxide ore zone by Mexican miners working on a small scale provided a last opportunity to obtain specimens from this zone, one in which the finer minerals are usually found. The extent of the mine workings at Ojuela are tremendous, for the ores were abundant and yielded rich returns. It is reported that there are about 200 miles of tunnels in this single mine. The mine workings are situated at the base of a high limestone *bufa* (cliff), 3,000 feet high and unscalable along most of its front. The name Ojuela ("little eye") is derived from one of the limestone spires of the cliff that is pierced by a small hole, suggesting the eye of a needle. To go from level to level in the mine, one must now use notched beams called "chicken ladders," and the search would have been difficult without the aid of the Mexican miners who knew the location of many pockets of the unusual ores.

FIG. 1.—Hauling mining machinery by oxcarts. Heavy supplies are often transported in this manner.

FIG. 2.—Pack burros transporting ore from the mine to the mill. Cusihuiriachic. These sturdy animals are much used for this heavy work.

FIG. 3.—The cathedral at Durango, built with the silver from the bonanzas of Guarisamey.

FIG. 4.—A cactus-lined road near Zimapan, Mexico. This cactus is useful for impenetrable fences and hedges.

The yield included a number of unusual arsenate minerals, some very rare, others well crystallized, and groups of scorodite, an arsenate of iron—the finest, I believe, yet to have been found. There were also specimens of fluorite of various colors, some clear and flawless and suitable for optical purposes, and others of a fine wine-red color suitable for gems.

From Ojuela, I attempted to reach by automobile the Sierra de Banderas, where large sulfur deposits are known to exist. The road led over a "barreal," or mud plain, and since this was the season when one could expect sudden and violent storms, we proceeded with one eye on the sky. When we were within sight of our objective, a tremendous storm broke. The deluge, fortunately, caught us on a small gravelly knoll, where we spent the night. The surrounding terrain was converted into a sea of soft, tenacious mud, and we spent almost the entire next day in returning to the main road 12 miles away.

Another prolific locality was Cerro Mercado, the famous iron mountain and Mexico's chief source of iron ore, just outside the city of Durango. Here huge banks of high-grade iron ore are mined by open quarry methods. These quarries are famous for their fine clear yellow apatite crystals, which are found in scattered pockets, in the mineable material, and I was fortunate in arriving at a time when these crystals were being obtained in unusual size as well as numbers. Many of these crystals are clear and flawless, of a sparkling yellow color, and are suitable for gem cutting.

A visit was made to Guanajuato, primarily to inspect the mineral collection of the late Don Ponciano Aguilar. Guanajuato is the center of an important mining area and has been the greatest producer of silver in the world. The rich ores consisted of beautifully crystallized silver minerals—argentite, pyrargyrite, polybasite, and others—but desirable museum specimens are now available for purchase only in an occasional old collection.

The mineral deposits of Mexico have received comparatively little attention from mineralogists, and precise information of the character of the ores from even some of the most prolific mining districts is very meager. Field work by the Smithsonian Institution, carried on intermittently since 1926, has resulted in the accumulation of the greatest collection of Mexican ores and minerals extant. During the 15 years this survey has been in progress, important mining districts have become exhausted and the minerals and ores are, even now, no longer obtainable. This material will be made the basis of two reports, one on the ore deposits and another on the minerals of Mexico.

THE THIRD EXPEDITION TO CENTRAL UTAH IN SEARCH OF DINOSAURS AND EXTINCT MAMMALS

By C. LEWIS GAZIN
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U. S. National Museum

The 1939 Smithsonian Institution expedition in search of the remains of extinct vertebrate animals in central Utah had for its special mission the further investigation of Cretaceous and Paleocene formations exposed along the east side of the Wasatch Plateau. It was hoped to obtain additional remains of dinosaurs and lizards from the older rocks and a greater representation of the Paleocene mammalian fauna.

The party, consisting of George F. Sternberg, Franklin Pearce, and the writer, met June 2 in Price, Utah. After assembling our camp equipment and supplies in Price, we proceeded by truck about 50 miles in a southwesterly direction into the mountains. Camp was made at a site locally known as Lone Pine Spring on the east slope of Wagon Road Ridge near its southern extremity, commanding an impressive view over the upper portion of Dragon Canyon toward North Horn Mountain.

Saddle horses were found indispensable in prospecting this region of few roads, strong relief, and scattered exposures. Also, the use of horses in getting large specimens from places of difficult access to roads where the large plastered blocks could be handled by truck was the only feasible solution to one of our most trying problems. Roads in the region, though graded yearly by the Forest Service, were generally rendered impassable for hours or even days after each rain. This particular year, however, was one of marked drought during the early summer, and in July the spring near which we were camped nearly stopped flowing so that it became necessary to haul water from another spring a few miles to the west. Heavy rains toward the end of the month made secure the water supply for the balance of the field season but greatly restricted the use of the truck.

Our first attack, after horses were obtained, was made on the Cretaceous outcrops along the westerly slope of North Horn Mountain. Here the party was successful in discovering fragmentary re-

Fig. 5.—Camp in the quaking aspens near Lone Pine Spring on Wagon Road Ridge, Manti Forest, Utah. Photograph by G. F. Sternberg.

Fig. 6.—View north across a portion of the newly discovered Paleocene locality in the western part of the Dragon Basin. Jaws and teeth of small, primitive mammals were found intermingled with concretions and pebbles in the foreground and along the lower slopes to the right in the middle background.

FIG. 7.—View to the southeast over the lower portion of Dragon Canyon, showing badland exposures of Cretaceous rock from which skeletons of extinct lizards were obtained.

FIG. 8.—Encasing portion of a ceratopsian skull with burlap soaked in plaster of paris prior to its removal. View of operations at a locality in Cretaceous rock exposed around the southeastern portion of North Horn Mountain.

mains of armored and trachodont Dinosauria new to the fauna and additional skull material of horned forms. A large part of one ceratopsian skull, badly checked, was discovered in a patch of exposures about midway along the west side of North Horn Mountain, and later a second skull portion of this type was found around toward the southeast part of the mountain.

In the latter part of the season investigation was made of several large exposures of the Cretaceous in Dragon Canyon, notably a locality in the lower part of the canyon which has now produced the remains of an astonishing array of large lizards, particularly remarkable since Cretaceous lizards were so poorly represented prior to discovery of the material at this locality in 1937. Remains of no less than 22 individuals were added to the collection this season, and it is anticipated that many of these, when completely prepared, will prove to include good portions of the skeleton.

Further investigation of the Paleocene deposits, principally those in Dragon Canyon, has added a number of new forms to the fauna, and has resulted in the discovery of a new locality, some distance to the west of the badland area previously worked. Material from the new locality was found to occur at two horizons, the upper of which appears to be equivalent to the fossiliferous Dragon horizon at the locality worked in previous years, whereas the lower level may be as old as the Puerco, as this stage of the Paleocene is represented in New Mexico.

Among the forms recognized in the Paleocene collections of this year, primitive mammals known as multituberculates, taeniodonts, and periptychids are representative of groups which became totally extinct in remote time. Remains found of other primitive types, such as insectivores and carnivores, belong to orders of mammals that have representatives in the living fauna. Included also were a notable variety of condylarths—archaic types that may have included the stems of our modern ungulates. The condylarths here represented were for the most part small animals, the diversification of which during Paleocene time must have been comparable to that of rodents in the living fauna.

By the early part of August about all the promising-looking exposures of Cretaceous and Paleocene rock around North Horn Mountain and in Dragon Canyon had been prospected, and there remained only the task of building boxes and packing the season's collection. This was done at a lumberyard in Price, which, being on a railroad, made a convenient shipping point. The field season was terminated there on August 12.

COLLECTING FOSSILS IN UTAH, NEVADA, TEXAS, AND THE MIDWEST

By JOSIAH BRIDGE
U. S. Geological Survey

AND

G. ARTHUR COOPER
U. S. National Museum

Gathering an important collection of fossils useful in the study of stratigraphy and paleontology requires careful planning and extensive field work. The National Museum collections of Paleozoic fossils, although fairly representative of United States stratigraphy, are lacking in fossils from some parts of the country and some portions of the geologic column. In order to correct some of these deficiencies, we planned to visit little-known or important localities in Utah, Nevada, Texas, and the Midwest. Our purpose was twofold, for besides the search for desired fossils, we wished to examine and collect from Lower Ordovician sections in the western States in order to obtain more exact information for use in the interregional correlation of these rocks.

Utah.—Our trip started in northeastern Utah. Bridge, who had been working about Eureka, Nev., for several weeks with a Geological Survey field party, came east and met Cooper at Salt Lake City. From here we went north to Logan to visit Dr. J. S. Williams, of Utah State Agricultural College, who took us to fine localities of Lower Ordovician rocks in Blacksmith Fork and Logan Canyons near Logan. While Bridge made detailed measurements of the long Lower Ordovician sequence in Blacksmith Fork Canyon, Cooper collected Mississippian fossils with Dr. Williams southeast of Logan. One of the prizes of the trip—a small but practically complete starfish, the oldest yet known in North America—was collected from the lower Ordovician Garden City formation in the Blacksmith Fork section.

Nevada.—At Eureka we joined the Geological Survey party, headed by T. B. Nolan, engaged in remapping the old Eureka Mining District. This area, located at the north end of the Fish Creek Range was formerly considered to have a relatively simple anticlinal structure. Actually it is an extremely complex structural unit, the correct

FIG. 9.—Antelope Range south-southwest of Eureka, Nev.

FIG. 10.—The Diamond Range northeast of Eureka after an early snowstorm.

FIG. 11.—Foothills just west of Spotted Range and east of Frenchman Flat, northwest of Las Vegas, Nev. Ordovician collecting locality in foreground at base of mountains.

FIG. 12.—Ikes Canyon, Toquima Range, southwest of Eureka, Nev., showing Lower Ordovician rocks at entrance to Canyon.

FIG. 13.—Looking north down New York Canyon from Diamond Mine toward Diamond Peak, Eureka, Nev.

interpretation of which requires most detailed mapping plus careful collecting of fossils from accurately determined strata in precisely placed localities. These collections are used to date the rocks containing them and serve to determine the superposition of the strata when the sequence is obscure. In such a region as this the fossils have a great practical value, besides their biological significance.

The geologic column at Eureka includes rocks from all parts of the Paleozoic era. Our interests were chiefly in those of the lower half of the Paleozoic—Cambrian to Devonian. We also collected Lower Ordovician fossils in the adjacent Antelope and Toquima Ranges. The Antelope Range lies about 40 miles south-southwest of Eureka and, like most other Basin ranges, is a tilted block. From it we took many fine fossils from the middle part of the Lower Ordovician. In the Toquima Range, located about 60 miles southwest of Eureka, we collected sponges, brachiopods, and trilobites from the upper part of the Lower Ordovician.

Our last collecting ground in Nevada was in a small range just west of the Spotted Range about 60 miles northwest of Las Vegas. Here the sequence includes strata ranging from Lower Ordovician to Mississippian in age, all tilted to the southeast. At the west base of the range, opposite Frenchman Flat, silicified Lower Ordovician fossils are abundant. Blocks of this rock showing an abundance of well-preserved fossils were selected to be dissolved in the laboratory. This treatment frees the silicified fossils from their matrix and often yields specimens preserving many delicate features which are ordinarily lost.

Texas.—In traveling from Las Vegas, Nev., to El Paso, Tex., we collected a lot of fine Upper Devonian fossils from soft shales exposed not far northeast of Silver City, N. Mex. The fossils weather free and are well preserved, and many fine specimens were obtained.

The Franklin Mountains, which terminate just north of El Paso, contain one of the type sections of Lower Ordovician rocks in the Southwest. In the arroyos and road cuts at, and just west of, the lookout on the Scenic Drive, which skirts the southern end of the range and overlooks the Rio Grande Valley and the cities of El Paso and Juarez, we collected Lower Ordovician fossils, many of them similar to some of those collected near Eureka and Blacksmith Fork. Among them were fragments of a second starfish of approximately the same age, but much larger and totally different in most respects from the one found in Utah. In the Hueco Mountains about 30 miles east of El Paso we collected Permian fossils while on our way to Van Horn.

FIG. 14.—Great algal reef in nearly horizontal Upper Cambrian rocks on San Saba River near Mason, Tex.

FIG. 15.—Northwest face of Beach Mountain showing Lower Ordovician strata in middle ground and the massive Upper Ordovician limestone capping the mountain. North of Van Horn, Tex.

Another fine, relatively undisturbed sequence of Lower Ordovician rocks similar to those at El Paso is exposed on the north end of Beach Mountain, about 10 miles north of Van Horn and just east of the escarpment of the Sierra Diablo Plateau. We collected at many horizons in this section.

One of the finest Permian sequences in the world is located in the Glass Mountains north of Marathon, Tex. The thickness of the column is rather variable, but on the average it contains between 6,000 and 7,000 feet of sediments, all dipping gently to the northwest. The limestones, at least those in the lower formations, abound in fossils many of which are well silicified and hence susceptible to etching in hydrochloric acid. We worked for 4 days in these mountains collecting from the Leonard and Word formations. We were fortunate in obtaining many fine specimens of two peculiar brachiopods: *Prorichthofenia,* having the shape of a coral; and *Leptodus,* a very aberrant brachiopod having the general shape of an oyster when seen from the ventral side. In *Leptodus* the dorsal valve consists of a series of narrow parallel-sided lobes extending laterally from a central axis. These lobate extensions fit over transverse parallel grooves extending laterally along each side of the central line inside the opposite valve.

After leaving Marathon we went to the Central Hill country of Texas to Mason and Llano. In the vicinity of these places we collected Cambrian fossils needed in the collections and also studied and collected from the Lower Ordovician Ellenburger limestone which is the partial equivalent of the El Paso limestone and of formations studied farther north and west.

In Jacks and Palo Pinto Counties west of Fort Worth we collected Pennsylvanian fossils weathered from shales and limestones well exposed in these counties. Mrs. J. H. Renfro and her daughter, collectors of Pennsylvanian fossils, took Cooper to two fine localities where many good specimens were obtained.

Oklahoma.—The Arbuckle Mountains and Criner Hills in south-central Oklahoma are low hills exposing a fine Paleozoic sequence. Here the Simpson group of the Middle Ordovician contains many fine fossils. We collected brachiopods and a few crinoids at several localities.

White Mound, a famous locality for Lower Devonian fossils, is a small bare hillock of disintegrating argillaceous limestone. It lies 3 miles west of Nebo, Okla., and about half a mile north of the county road. The fossils, which are extremely abundant, weather free from the enclosing limestone and can be picked up from the surface of the

FIG. 16.—Ford over San Saba River just east of Camp San Saba, Tex., showing brachiopod beds of the Upper Cambrian.

FIG. 17.—White Mound west-northwest of Nebo, Okla.

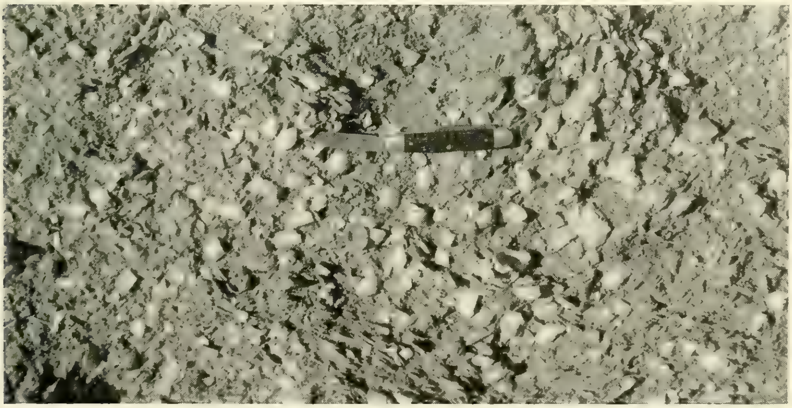

FIG. 18.—Loose Ordovician fossils weathered from shale on roadside $1\frac{1}{2}$ miles west of Nebo, Okla.

ground. We collected from the mound and from the slopes of the low hills just southeast of it and obtained a large number of specimens.

Missouri.—At Rolla we visited the offices of the Missouri Geological Survey, and the Department of Geology at the Missouri School of Mines, and collected from the small Devonian outlier just west of the city. In the Ozarks fossils commonly occur in the chert, which replaces much of the limestone. In the country about Eminence good specimens were abundant. From Eminence we went east to Cape Girardeau to see Upper Ordovician and Silurian strata. With Perryville as our headquarters for several days we collected fossils in the Little Saline Valley which contains a long complexly faulted Paleozoic sequence. Our chief interest here was the Bainbridge limestone of Middle Silurian age, containing many crinoids, blastoids, and brachiopods. As none of this material was represented in the Museum collections, we selected many blocks to be broken up in the laboratory. In addition to the Silurian fossils we collected specimens from the Middle Ordovician and Lower and Middle Devonian rocks. On our way to Indiana we stopped at Louisiana, Mo., to see F. R. Long, collector of Silurian fossils.

Indiana.—Southwest of Logansport on the Wabash River and not far east of the little village of Georgetown occurs a large exposure of Silurian dolomite. From a small undolomitized portion of this outcrop we collected many brachiopods. From this place we went south to New Albany to collect Devonian and Mississippian fossils under the guidance of Guy Campbell.

In summary it should be said that we covered about 8,000 miles on our trip, visited a number of localities that brought fossils to the Museum not previously represented in the collections and studied Lower Ordovician strata in five States, obtaining good collections and much data useful in correlation.

COLLECTING ORDOVICIAN FOSSILS IN THE SOUTHERN APPALACHIANS

By G. ARTHUR COOPER
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The Southern Appalachians comprise a vast territory still imperfectly understood by geologists. State geological maps have been prepared of Alabama, Georgia, Tennessee, and Virginia, and portions of these States have been studied in detail. The major geologic structures and the essentials of the stratigraphy are well known, but no comprehensive faunal studies have ever been undertaken in the Southern Appalachians. In order to facilitate studies of Ordovician brachiopods from this region now under way, the writer spent the month of May 1939 in this region with Charles Butts and Josiah Bridge. Mr. Butts, while a member of the United States Geological Survey, mapped the Appalachian structures and strata of Alabama and Virginia. Mr. Bridge, geologist of the United States Geological Survey, is now engaged in mapping parts of Tennessee. The writer was thus most fortunate in having expert guidance in the field.

Although study of the fossils of most parts of the extensive Paleozoic column of the Southern Appalachians has been much neglected, the party centered its interest on the rocks and fossils of the lower Middle Ordovician. The Stones River group, or lowest part of this sequence, consists almost wholly of limestone. The overlying Blount group contains much shale with intercalated limestone and marble beds. Above the Blount group occurs thin-bedded limestone of the Black River group, which in places is red in color. In addition to these groups, the black Athens shale, which is generally believed to belong to the Blount group, overlies the Stones River limestone or some portion of the lower Blount. It is not yet clear whether this black shale is equivalent to all of the Blount group or only a part of it.

The rocks of the Southern Appalachians occur in long northeastwardly trending belts formed by the deformation of once nearly horizontal sediments. In late Pennsylvanian and Permian times the rocks of this region were shoved northwestward by forces not fully understood. This produced great wrinkles and shortened the earth's crust many miles. Erosion has etched the wrinkles into elongate ridges, of which Clinch Mountain is a conspicuous example. These

FIG. 19.—Clinch sandstone on south side of Clinch Mountain, south of Eidson, Tenn. This resistant sandstone forms the backbone of this long mountain.

FIG. 20.—Black River limestone at Chattanooga, Tenn. The man on the right is standing on a soft bed of volcanic ash or bentonite, which indicates presence of active volcanoes in Ordovician time. Photograph by J. Bridge.

Fig. 21.—Porterfield Quarry, 5 miles east of Saltville, Va., showing steeply dipping Stones River limestone.

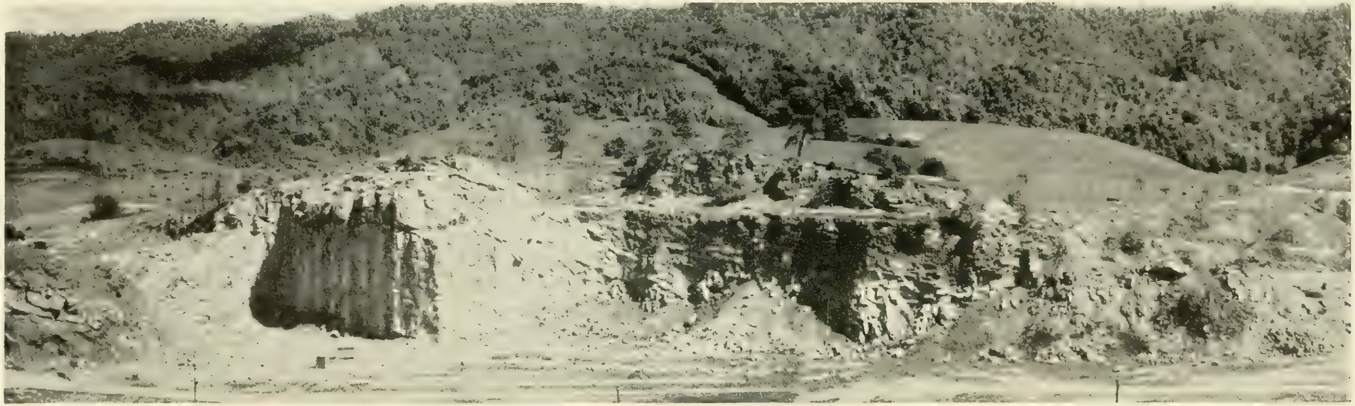

Fig. 22.—Same quarry showing reef or bioherm at base of Blount Group. Right side of figure 21 connects with left side of this figure. Photograph by J. Bridge.

ridges are developed along the outcrop of resistant formations and are separated from each other by parallel valleys etched on the limestones. In the process of folding, the rocks often cracked, and large plates were shoved long distances from the southeast. These thrusts, as the geologists call them, bring younger rocks over older ones and thus tend to complicate the true relationships of the strata and their contained fossils. In the Southern Appalachians these thrusts have brought into superposition rocks originally deposited in widely separated parts of the same sea. Full understanding of this region thus depends on the recognition and correct interpretation of the thrust-plates.

Investigations and collecting were begun about 18 miles southwest of Montevallo, Ala., at Pratts Ferry, where the Paleozoic structures disappear under the flat-lying Cretaceous sediments of the Coastal Plain. From here the party proceeded northeastward to Pelham, Birmingham, Odenville, and Leeds, Ala. More specimens were collected in northeastern Georgia on Chickamauga Creek and at Rock Springs south of Chattanooga.

From Chattanooga the party moved north to the long and narrow Sequatchie Valley, where a fine Ordovician sequence containing many Stones River fossils occurs near Pikesville. East of Athens, Tenn., a great belt of Ordovician rocks runs northeastwardly to Knoxville. The party followed this belt from Riceville through Friendsville, collecting fossils and noting the lateral passage of the shales at Riceville into limestone at Knoxville. After collecting trilobites at Bulls Gap northeast of Knoxville, the party moved northwestward to Cumberland Gap for a few days to study the limestones of the upper Blount and Black River groups.

In southern Virginia fossils were collected from the Blount shale belt running northeast from Gate City. East of Saltville, Va., a large quarry exposes a reef or bioherm at the base of the Blount, in which echinoderms and other fossils are especially abundant. Collections were also taken from the Stones River beds at Marion, near Salem and Lexington, where fossils occur loose in residual soil. Near Harrisonburg fossils were collected east of the city and at places along United States Highway 11 as far north as Strasburg. The high Black River beds at Strasburg abound in good fossils.

The writer was particularly interested in finding silicified fossils; for these can be freed from their limestone matrix by dissolving the enclosing rock in acid. Many specimens thus preserved were obtained on this trip, and the Southern Appalachians proved to be a rich source of fine fossils.

QUARRYING FOSSIL SEA URCHINS

By JAMES H. BENN

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In July 1939 Dr. William F. Foshag of the Museum staff, while upon vacation at Scientists Cliffs, Port Republic, Md., came upon some curious fragmentary calcareous plates lying at the foot of a bluff overlooking Chesapeake Bay. Investigating further, he found someone had been digging in the loose, unconsolidated sand and clay some 18 or 20 feet above the beach, from whence the fragments had been dislodged. Proceeding then to do some prospecting of his own in these abandoned diggings, he soon began to uncover what appeared to be a rich deposit of beautifully preserved fossil sea urchins (echinoids). Collecting a fine representative group of specimens, he returned to Washington and submitted them to the proper Museum authorities. Soon thereafter I received a detail to proceed to this locality and obtain a large group for the Museum exhibits.

Arriving at the cliffs on July 17, I joined Drs. Foshag, Kellogg, Resser, and Cooper, all of the National Museum staff, who were studying the locality from various standpoints.

Mr. Gravett, owner of Scientists Cliffs, assigned me a site for my camp, which was soon in order; in company with Drs. Foshag and Kellogg, I then proceeded to investigate the deposit which lay less than a mile north along the beach from Scientists Cliffs and from 18 to 20 feet up in the bluffs on the western shore of Chesapeake Bay.

The sea urchins lay imbedded in a loose, uncemented sand in company with a fair number of barnacles and an occasional sand dollar. The thickness of the layer of fossils was no greater than 8 inches and in places much less. The width was approximately $3\frac{1}{2}$ feet. The axis of the deposit was at a northwest variance with north-south trend of the bluff, the fossil bed appearing at the southerly apex of the angle thus formed and disappearing northwesterly into the bluff. Dr. Foshag had cut away a space in the bluff large enough to make this trend very apparent.

The next day, plotting of the slab to be taken out was begun. Because of the weight of the material, it was decided to take the piece out in three sections. Accordingly chalk lines were laid out and the work of quarrying started. This was carefully done, as the specimens lying in the path between the slabs were fragile, and a successful attempt was made to quarry these as well.

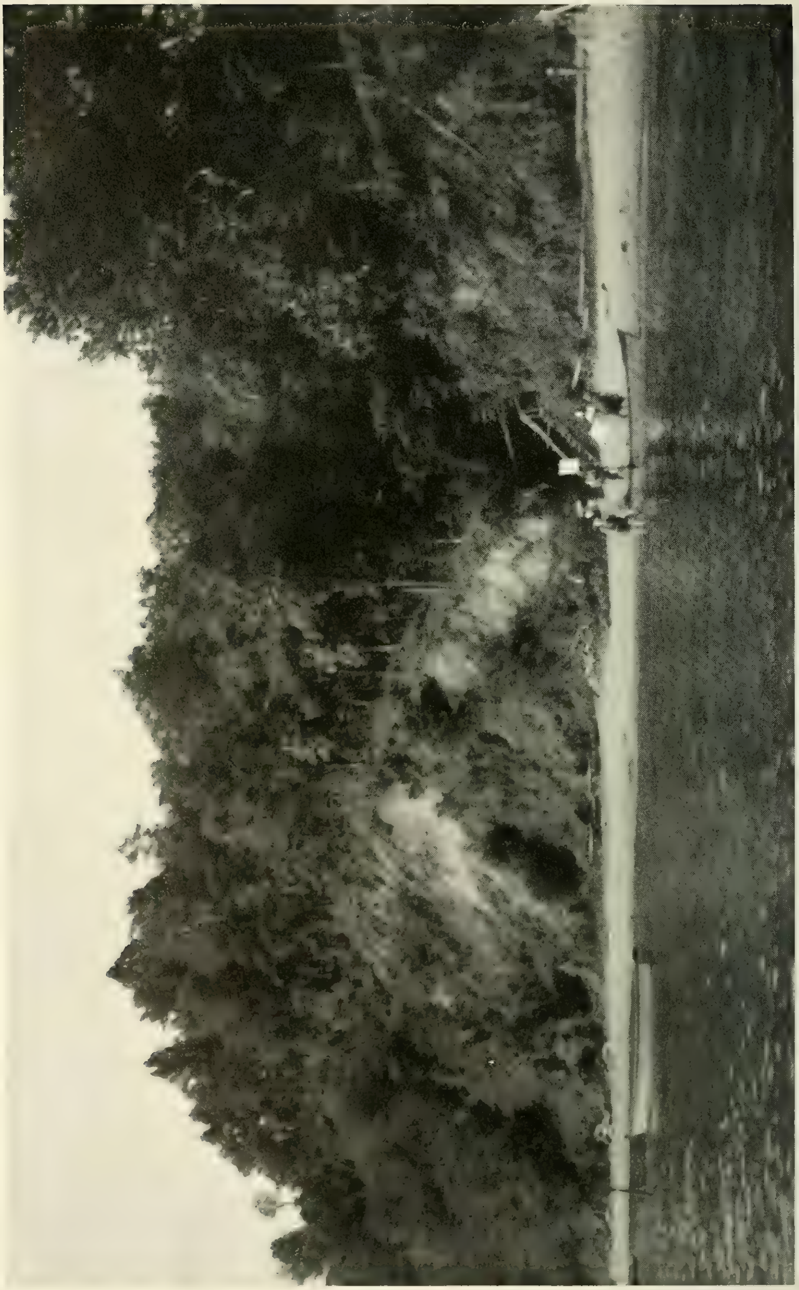

Fig. 23.—Outcrop of the Miocene-Choptank formation at Scientists Cliffs, Md.

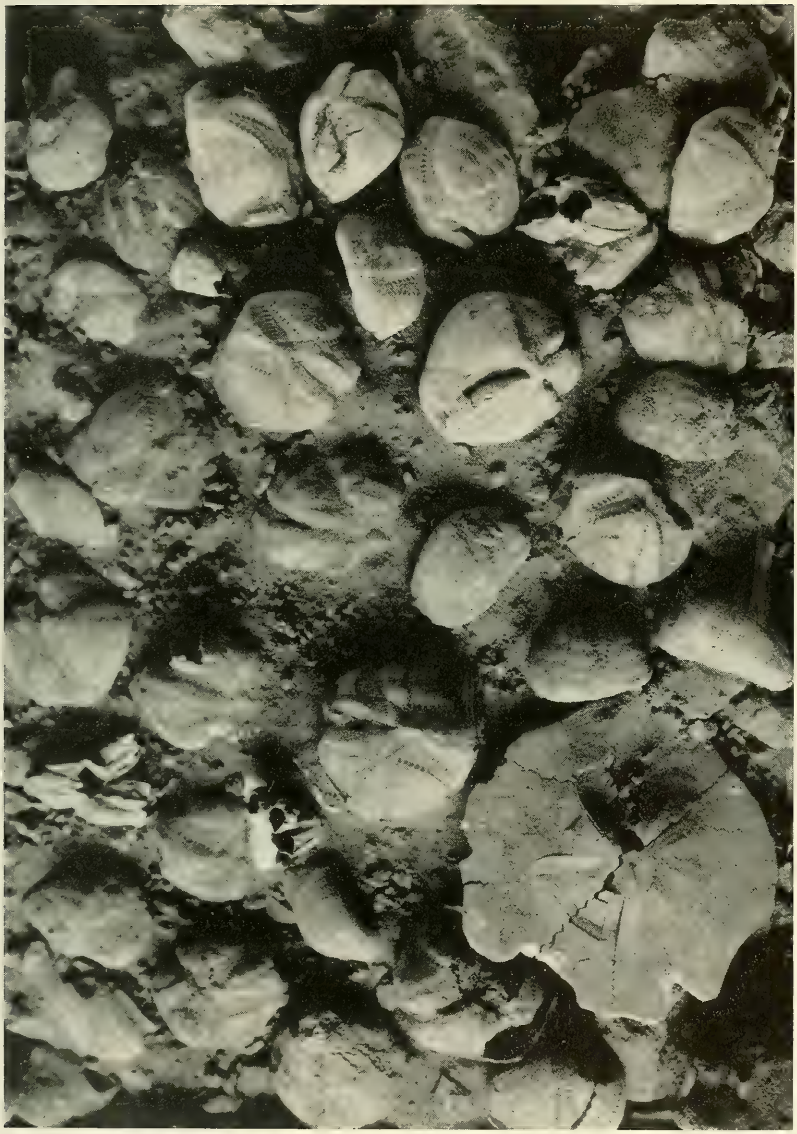

FIG. 24.—Reduced view of a portion (12×15 inches) of the Scientists Cliffs echinoid slab.

For the rest of the week this work continued, although spasmodically, because rainy weather set in. Each time it rained, the sections would have to be covered to protect them; otherwise they would have washed out. At times it was a matter of conjecture as to whether the Museum or the rain would get the specimens. However, by Saturday, the sections had been secured in wooden frames and a heartfelt sigh of relief went up. The following days were devoted to plastering a heavy protective coat over the faces and bottoms of the sections. When the plaster had set, wooden covers and bottoms were nailed to the frames for final reenforcement.

On July 25, encasement of the sections being completed, the task of conveying them safely to the Museum was begun. The sections were first slid from their place in the bluff to rowboats waiting on the beach to take them to the landing at Scientists Cliffs. They were then carried up the stairs to the top of the bluff and loaded on a Museum truck for transportation to Washington.

The sea urchin (*Echinocardium orthonotum*) found at this locality, until now has been rather rare. It was first described in 1843 by Conrad in the Proceedings of the Academy of Natural Sciences of Philadelphia, volume 1, page 327. A figured specimen by Forbes is illustrated in the Maryland Geological Survey Miocene Text and was obtained by Lyell. Both specimens were found near Coggin's Point on the James River, Va., and came from the Choptank formation of the Miocene. Those at Scientists Cliffs likewise come from the Choptank formation and may well be the first Maryland record. It has been learned that the diggings which Dr. Foshag found, and which were subsequently worked by the Museum, were discovered and made by Miss Lois M. Schoonover of Bryn Mawr College. She found the first specimen during the summer of 1938 and returned in November of the same year and obtained many perfect specimens.

Sea urchins (echinoids), which belong to the great phylum Echinoderma, occur sparingly in all formations from the early Paleozoic deposits to the youngest. Many sea urchins from the Cretaceous formations were dug out by the ice during the Glacial Epoch and scattered over the countries of northern Europe, where they played a great part in the superstitions of ancient times. As they were supposed to have fallen from heaven with the thunder, they were believed to provide protection against thunder and indeed prehistoric man used them as amulets.

The preparation of the slab, now under way, is revealing many excellent entire specimens and will result without doubt in a very unusual and instructive museum exhibit.

BRINGING LIVE ANIMALS FROM THE ARGENTINE

By W. M. MANN
Director, National Zoological Park

Early in April 1939 the writer, accompanied by Mrs. Mann, Mr. and Mrs. William Shippen, of the Washington Evening Star, and Dr. John Gray, sailed from New York on the S. S. *Uruguay,* of the American Republics Line, for Argentina. Mr. Shippen was sent by his newspaper to write a series of travelogs on South America. Dr. Gray went to make observations on economics. Our work was to gather and bring back to the National Zoological Park in Washington a collection of southern specimens.

Before leaving, we had ascertained that certain North American species were desired by the zoos of the Argentine, and we took with us as an exchange 20 crates of live animals and birds, including bison, Texas red wolves, prairie dogs, and American bald eagles.

There was ample time in Rio de Janeiro for us to visit the zoo and make arrangements with Dr. Drummond, the director, to have a few things ready for us on our return voyage. At Sao Paulo we left some gila monsters for the famous snake farm and research institute at Butantan, and arranged for exchanges with the director.

The care of 20 crates of animals is not a very heavy duty, but it kept us occupied some hours each day. One of the buffaloes in some unaccountable way got turned around in his cage at night and spent the rest of the voyage kicking and fighting. There did not seem a chance of his arriving alive, yet he was turned out of his crate into a comfortable paddock in the zoo at Buenos Aires looking only a little tired. One of the Texas red wolves had a litter of five cubs a couple of weeks after arriving, so there was an increase instead of a loss in our shipment.

From the time we arrived in Buenos Aires until we sailed 6 weeks later, there was no lost time. The United States Consul General, Monnett B. Davis, and Dr. A. Holmberg, director of the municipal zoo at Buenos Aires, had things arranged for us. Almost immediately the Minister of Agriculture lent us a comfortable and commodious launch and sent us up the Delta of the Parana, through the rich agricultural lands, to the Parana River itself. Here we visited a large fur farm, where coypus, called nutrias in the Argentine, were being raised by the hundreds.

Fig. 25.—Shelters for snakes in the Instituto Butantan, near Sao Paulo, Brazil.

Fig. 26.—In the Buenos Aires Zoo.

FIG. 27.—Elephant house and yard in the Cordoba Zoo.

FIG. 28.—Coypu pens in the model coypu farm at Laguna Colis.

The Governor of Cordoba sent us into the mountains of his province, where we found among other things the International Postal Convention, at that time making a tour of the country. The zoo at Cordoba, though small, is excellent, and we were presented with a number of specimens which we brought back to Buenos Aires on the train with us.

Two residents of Buenos Aires, Senor Picardo and Senor Antelo, motored us to their nutria farm, Laguna Colis, south of Buenos Aires, where we saw great flocks of flamingos, black-necked swans, coscoroba geese, and other waterfowl as well as the nutrias kept for breeding there. Mr. Roosmalen, the manager of the *estancia,* presented us with breeding pairs of these interesting animals. They have had young since arriving in Washington.

At La Plata our old friend Dr. C. A. Marelli greeted us, and we spent some time in the beautiful zoo there, incidentally obtaining some rare birds and a pair of hurones or grisons.

Our last trip, as guests of the National Parks of the Argentine, took us to Nahuel Huapi, at the base of the Andes. Here in a beautiful lake is Victoria Island, where wild life is being introduced as well as preserved. Guanacos were running about, and there was a flock of black-necked swans on a little lake on the island. The huimil, the interesting deer of the Argentine, is becoming very scarce, but a serious attempt is being made to preserve it. European wild boar, introduced in the vicinity some years ago, have become a nuisance.

The two oldest North American families in the Argentine, the Joneses and the Newberys, both have ranches in Patagonia. These families were really the pioneers of this part of Argentina. We visited both *estancias* and were received with the greatest hospitality and friendship.

Through exchange, gifts, and a few purchases our collection soon was as great as we thought we could care for on the return trip. Specimens came in from all quarters. Tom Davis, son of the Consul General, made it his job to get for us a fine collection of turtles. A police inspector whom we met casually on the train going to Patagonia had rheas waiting for us on the railroad station platform at the little town of Patagonas when we passed through there coming back. Natalio Botana, of the newspaper La Critica, and his son presented us with a fine series of two species of tinamou, as well as some small mammals. The zoos of Buenos Aires, La Plata, and Cordoba all helped. The last evening before sailing Senor José Cinaghi, a local animal dealer, called to say good-bye. He mentioned the fact that I had not bought anything from him. I explained that I had 41

FIG. 29.—Monkey island in La Plata Zoo.

FIG. 30.—Lake Moreno in Patagonia. Chile is an hour away by launch.

crates of animals, and that was enough for us to take care of. He replied, "No, you have 43 crates, because I have already sent two crates of ducks and black-necked swans to the boat for you." Mrs. Shippen discovered three rare *escuerzo* frogs (*Ceratophrys*), that were particularly desired, in a pet store in the shopping district of Buenos Aires. Senor Ennio Arrigutti, of the Aquarium Kin Yu, gave us a number of small interesting creatures that we wanted.

When we arrived in Rio de Janeiro, more specimens were awaiting us—snakes from the Instituto Butantan, tapirs and king vultures from the zoo, and numerous other things from friends. There were 70 cages of animals in our collection when we arrived in New York, and all of them came to Washington in good condition. On board ship, the two ladies of our party devoted their mornings to caring for a line of specimens assigned to them. Mr. Shippen acted as chief water boy; his first duty each morning was to remove water pans from 60 cages, wash them, and put them back filled. The ship's butcher and the second cook ground up meat and vegetables for us, and the bos'n's mate and another sailor came to the rescue with much hard labor during their hours off.

We are under great obligation to the Moore McCormack Line for marvelous quarters given us for the animals and for their complete cooperation. The animals that required quarantine were taken care of in New York by L. Ruhe and Company; and Howard Fyfe, United States Despatch Agent, had already made the necessary arrangements with the Express Company for the immediate shipment to Washington of the other animals.

All in all, the trip resulted in the addition of 316 specimens to the National Zoological Park, all of them needed by the Zoo and some of them never exhibited here before.

Among the animals were guanacos and llamas, new blood for our herds; capybaras, pampas cats, a pair of Brazilian tapirs; a pair of Andean condors, upland geese, black-necked swans, coscoroba geese, 21 Chilean flamingos; and numerous reptiles, some from the Instituto Butantan.

AN ORNITHOLOGIST IN SOUTHERN MEXICO

By ALEXANDER WETMORE
Assistant Secretary, Smithsonian Institution

The connection between archeology, the ancient Maya, and modern birds may seem remote. But in Matthew Stirling's camp for the National Geographic Society-Smithsonian Institution Archeological Expedition to Veracruz I found last spring pleasant quarters for ornithological studies in a fascinating region. In Mexico City, through Señor Juan Zinser, then Jefe del Servicio de Caza of the Departmento Forestal y de Caza y Pesca, I received the necessary permit to allow the collection of birds for scientific study, and in Veracruz City through the courtesy of Gen. Alejandro Manje, Comandante de la 26a Zona Militar en Veracruz, the proper papers authorizing the bearing of arms for hunting.

One is always impatient to be afield in new territory, and my companion Richard Stewart, staff photographer of the National Geographic Society, and I felt that our expedition had only really begun when on the morning of March 5 we left Veracruz on a combination freight and passenger train for Alvarado. Tantalizing glimpses of brown jays, cardinals more brilliantly red than the familiar friend we knew at home, and other more obscure birds that I could not identify from the car window aroused enthusiasm, as did the gulls, pelicans, ducks, and cormorants seen from the steamer launch *Eustolita* that carried us up the Río Papaloapan to the fine old town of Tlacotalpan. The following morning we were really on our way when we embarked in the "canoa" *La Delfinita* with Pedro Barán, and traveled through winding channels, many of them narrow and choked with water hyacinth, until noon brought us to the landing at Boca San Miguel. Our field outfit was soon loaded into an oxcart, and after a 2-hour ride on muleback we reached the camp a mile beyond the village of Tres Zapotes.

The location was ideal for the ornithologist. The three palm thatch houses of the camp were built on elevated ground above a small savanna, with dense jungle at the side. The land was slightly undulating, cut by small arroyos of clear water, and we looked out from the houses across open pastures to the Volcán de Tuxtla, with the low slopes of Cerro Prieto and the distant peak of Volcán San Martín in the distance. Farmers living in the village had cleared considerable tracts which were planted in corn. Other sections where

FIG. 31.—The field outfit enroute to camp by oxcart, March 6, 1939.

FIG. 32.—A ford on the Arroyo Tres Zapotes.

FIG. 33.—The palm-thatch laboratory and photographic dark room.

FIG. 34.—Mules furnished transportation to Arroyo Corredor and other distant points.

tough-rooted grass had invaded and taken over these cultivated milpas were returning again to the densest jungle. Large areas were covered with good sized trees. The general elevation was less than 200 feet above the sea, and the whole area lay in the humid section of the tropical zone.

There followed interesting days in rapid procession. Stewart needed a dark room for his photography, and I, space to store my birds, so Juan Santos, local architect, built for us a house of poles and bamboo, bound together with tough vines and thatched skillfully with palm leaves, all cut in the nearby forest. The morning alarm clock, half an hour before dawn, was the complaining cry of the large brown jays, and at night I fell asleep to the insistent *who are you' who are' you* of goatsuckers (*Nyctidromus albicollis*) that came out of the forest at dusk to watch for insects in our clearing.

Birds of many kinds abounded in the forest, and each day brought its new kinds of strange form and interesting color. With Ramón as assistant, to carry the game bag and to clear trail with his machete where necessary, I spent my mornings afield in search of specimens. Flycatchers, tanagers, wrens, thrushes, and woodpeckers abounded, with hawks, toucans, owls and many others of larger or smaller size. And with these were multitudes of familiar birds from the eastern United States here for the winter, their numbers increasing in early April as the northward migration began and a vast horde came pouring through this relatively narrow stretch of land at the northern end of the Isthmus of Tehuantepec from winter quarters to the south of us. Among these, magnolia warblers were especially common, and in early April I saw more orchard orioles than I had observed in all my previous years as a naturalist. Lincoln's sparrows fed in our clearing with all the familiarity of dooryard song sparrows, so that I gained an entirely new idea of this species that I had known previously in the north only as a shy migrant. Occasionally I had glimpses of the more timid yellow-breasted chats; or summer tanagers or indigo buntings appeared.

In the pleasant afternoons, as I worked on specimens or notes under the sheltering porch of our house, the clear, varied song of the spotted-breasted wren (*Pheugopedius maculipectus*) came from the adjacent jungle, flocks of black vultures wheeled over the open pastures, yellow-breasted flycatchers of several kinds called from the trees, and there was a constant flitting of redstarts, gnatcatchers, and others of the smaller species through the bushes bordering the clearing. From the adjacent forest there came continually strange calls and songs, some of which after 6 weeks remained unidentified.

FIG. 35.—The heavily wooded swamp at Laguna Grande.

FIG. 36.—Embarking on the launch at Boca San Miguel, April 15, 1939.

For the first 2 weeks I was content to work in the vicinity of camp and of the village. Several small lagoons offered variety in the way of water birds, and the thickets seemed to have a never-ending supply of unusual species. Then with mules I began to travel farther afield along narrow trails, where the crossings of the arroyos often seemed bottomless in sticky mud. It was always pleasant in the cool air of early morning to ride out this way, watching from the elevation of the saddle the small birds in the trailside bushes, observing the spiraling flocks of great hawks in migration northward, and hearing on every hand the harsh calls of dozens of chachalacas.

At the Arroyo Corredor we found a large tract of swampy woodland, in some sections clear of undergrowth, where curious warblers and tanagers and other unusual species abounded. The Arroyo Teponaguasapan with its dense jungle without trails offered a decided contrast, while at Para Madera the low-lying land was more open, leading to marshy savannas beyond.

At the end of March rains fell less frequently, the sticky mud disappeared from the trails, and the cold winds of the *Norteros* blew only occasionally. The midday sun became hot and oppressive. Various kinds of native birds that had been common lessened in number, and I had the impression that they had withdrawn from this lowland area toward the mountains, while others seemed to come to take their places.

Our daily life was filled completely with absorbing tasks with little outside interruption. In this isolated region there was no telegraph or telephone nearer than 8 hours' ride, and mail arrived at infrequent intervals when a launch from one of the stores in the village brought supplies from Tlacotalpan. In the evening we usually gathered at sundown to rest for an hour to talk and watch the fading light on the mountains, and to listen to the bird and animal voices about us. Mingled with these there was often the sound of the distant singing and music of dances in the village, and on occasion little orchestras passing on the trail to San Juan stopped to visit and to play for us.

By the middle of April I had a fairly representative collection of this interesting region that will give definite information regarding its varied bird life. The data are especially important in giving details of distribution of variable forms and information on the always fascinating subject of the movements of our northern migrants.

Our work continued until the last possible moment, and we all felt regret when on April 15 the last of our luggage was placed on the pack mules, and we ourselves mounted to ride down to take the launch at La Boca.

COLLECTING BIRDS AND MAMMALS IN NORTH CAROLINA

By W. M. PERRYGO
Division of Mammals, U. S. National Museum

To continue the study of the geographic distribution of birds and mammals in our mountainous States in the Southeast, from which a representative collection has been lacking in the National Museum, the officials of the Museum decided to work this year in North Carolina. This State is most interesting for this type of work because of its variety of terrain. On the broad coastal plain are vast areas covered by pine and cane, with great cypress swamps along the lower courses of the many streams. The central part of the State, the Piedmont area, with its broad farms and wooded hills leads gradually into the western mountains, and so to the high crest of the Appalachian Range.

Throughout the season we had the cooperation of J. D. Chalk, Commissioner of Game and Fish, Department of Conservation, at Raleigh; also the help of officials connected with the National Forests and of the many land owners on whose land we collected.

With Gregor Rohwer as my field assistant, I left in April 1939 to begin work in the northeastern part of the State near Elizabeth City. Here we remained for 2 weeks working in the cypress swamps in pine woods, along river banks, and through the farm lands searching for the desired birds and mammals. As the spring migration began in full force, we moved inland to Sampson County in the vicinity of Clinton and worked along the streams and cypress swamps, obtaining many interesting specimens.

The first week in May we continued down to Brunswick County in the lower austral zone of the extreme southeastern part of the State, establishing a base at Southport. Here we found beautiful painted buntings, with blue head, green back, and red breast; brown-headed nuthatches; red-cockaded woodpeckers; towhees with white eyes; and many other interesting denizens of the southern woods. While here, we crossed to Smith Island, where we made some very interesting collections.

Moving to Richmond County for the latter part of May, we worked in the cotton- and corn-growing section along the Pee Dee River near Rockingham. The early part of June found us in Cherokee County near Murphy, in the extreme southwest, investigating

FIG. 37.—Good collecting country near Elizabeth City.

FIG. 38.—Cypress swamp in early spring, near Elizabeth City.

FIG. 39.—The wooded reaches of Town Creek between Wilmington and Southport.

FIG. 40.—Perrygo and Wheeler with the field truck, taken near Engelhard.

the mountains, the highest in this region being Pack Mountain. Completing studies here, we went east to Franklin and worked in the Nantahala National Forest on Wayah Bald, Standing Indian, and adjoining mountains. These mountains are well over 5,000 feet, but being so far south, near the Georgia line, they lack the balsam and spruce trees found at similar altitudes a little farther north, and therefore northern forms of birds and mammals do not occur.

We spent the first half of July in the beautiful and mountainous section in the northeast, collecting on Three Tops, Elk Knob, Snake Mountain, and other adjoining mountains, obtaining a fair number of specimens considering the heavy rains, which hamper work of this kind. On July 22, we returned to Washington.

For work in the autumn I left Washington on September 14, with Charles Wheeler as field assistant. Our first area was in Rockingham County in the north-central part of the State, where we collected along the headwaters of the Dan and Haw Rivers. The latter part of September we moved southwest to Iredell and Catawba Counties, where most of our work was confined to the wooded bottom lands of the Catawba River. On October 10 we continued east to the low, flat, and swampy sections of Hyde and Dare Counties near Engelhard and Stumpy Point. This is hunting country, where deer and other game abound, and we obtained many birds and mammals typical of this low coastal region. While here we were joined for a few days by Dr. Alexander Wetmore and J. E. Graf, of the Smithsonian Institution.

Our camp was on the south shore of Lake Mattasmuskeet, and during a day or two of cold we saw the arrival of the first Canada geese from the north. Through the courtesy of the Biological Survey we had permission to trap for mice and shrews in the nearby Wild Life Refuge, and here we obtained excellent specimens.

Leaving Engelhard on November 1 we moved west to Pitt County to the vicinity of Bethel. Along Conetoe Creek we found some excellent stands of hardwood trees, where collecting was good. Northwest of Greenville in Pitt County were large tracts of pine woods, where we found white-eyed towhees, brown-headed nuthatches, and red-cockaded woodpeckers.

Our last 2 weeks were spent in and near Beaufort in Carteret County, working in the salt marshes and low pine lands, and at the end of November we returned to Washington.

The results of the season include an excellent representation of the birds of the State. Small mammals were scarce except along the coastal plain, and few were obtained in the Piedmont area.

BIRD STUDY IN EUROPEAN MUSEUMS

By H. G. DEIGNAN

Scientific Aid, Division of Birds, U. S. National Museum

With the aid of a grant from the American Association of Museums I was enabled to spend over 3 months in Europe studying type material and other relevant specimens in connection with my work on the birds of Siam. In all the museums visited, Mrs. Deignan assisted by searching the catalogs and records for pertinent entries and by transcribing these data, thereby greatly facilitating and speeding up the work and making it possible to cover as many collections as were actually examined.

The month of June 1939 was spent chiefly in London, where work was carried out at the British Museum (Natural History) and, to a lesser extent, at the private museum of Dr. C. B. Ticehurst in Kent. By examination of many type specimens of Asiatic birds and, in other cases, of topotypical material, it was possible to identify with certainty a large number of specimens brought over for study from the United States National Museum. Because of the danger of complete destruction of type specimens during the political upheaval (now war) in Europe, wherever possible the United States National Museum specimen most nearly identical with the type was so indicated for future reference. Also, certain descriptions originally published in books now very rare and not to be found in any American library were copied verbatim, and these copies have been deposited in the divisional library at the United States National Museum. Some of these were found in the British Museum and others at the library of the Zoological Society of London.

The first week of July was spent working at the National Museum of Natural History in Paris, where many types of birds from French Indo-China were examined, and old and, in some cases, misidentified records from Siam were checked. Following this a week was passed in Vienna and the next week in Berlin. The Viennese collections contained relatively little pertinent material, but in Berlin the Müller collection (with types) was studied and it was learned definitely that the old Schomburgk collection, one of the pioneer sources of Siamese ornithology, is no longer in existence.

The last week of July was spent at Hannover, where there is an extensive collection from Siam, most of it unidentified and unpub-

FIG. 41.—Exterior of the Biological Museum at Skansen, a park in Stockholm.

FIG. 42.—Exterior of the Museum of Nordic Culture and Ethnology, in Stockholm.

FIG. 43.—Part of the unique panoramic exhibit of the vertebrate fauna of Sweden in the Biological Museum, Stockholm.

FIG. 44.—Another part of the same exhibit.

lished. The birds were stored in the attic of a closed palace, in great disorder and without proper care. As for many years no ornithologist had visited the museum, the visit was welcomed by the director, who detailed a man to assist in labeling the specimens as they were identified.

A brief stop was made in Bremen, where there is supposed to be a mysterious type specimen from Bangkok, but in the absence of the director of the museum, it was not possible to search for it.

The month of August was spent in Sweden, chiefly in Stockholm where there is a major Siamese collection housed in the most up-to-date of European museums. Part of the collection was reported on in 1913 and 1916, but many hundreds of specimens of later date, never formally recorded, were also found, among them at least four species new to northern Siam. In addition, permission was kindly given to study a recently received small collection from that area which included one more species new to the country.

With the work in the museum completed and 2 weeks still available before the date of sailing to New York, a field trip to Swedish Lappland was undertaken, headquarters being made some 60 miles north of the Arctic Circle. Some hundreds of specimens of invertebrates and lower vertebrates were collected there and brought back to Washington; their number was augmented by further sporadic collecting in the vicinity of Stockholm. Such specimens have an added value in that Sweden and Lappland are type localities for a large proportion of the fauna of northern Europe.

Upon the imminent outbreak of war, the date of sailing was advanced a week and the port of departure changed from Hamburg to Southampton. This necessitated a hurried trip from Sweden to England, but the ship was reached in time and the work in hand was in no way affected by the change of plans.

THE NAVY SURVEYING EXPEDITION TO THE PHOENIX AND SAMOAN ISLANDS, 1939

By LEONARD P. SCHULTZ

Curator, Division of Fishes, U. S. National Museum

When the Smithsonian Institution informed me that I was to accompany the U.S.S. *Bushnell* as naturalist to collect material for the United States National Museum, I was delighted to have the opportunity to take specimens on seldom-visited islands of the South Pacific Ocean.

Without the aid of two enlisted men, Charles W. Rackliffe and Arthur Petit, pharmacist's mates on the U.S.S. *Bushnell,* who were kindly given permission to help me by Dr. H. D. Hubbard (Comdr. U.S.N., M.C.) it would have been impossible for me to have obtained as much material as I did.

I left San Diego April 1 on the U.S.S. *Bushnell* (fig. 45), and after a few days spent at Pearl Harbor, T. H., my field work began on Canton Island April 23. This coral atoll, about 9 miles long and 3 or 4 miles wide, contains a large lagoon (fig. 46), rich in marine life. During the next 5 days I was able to collect many specimens of fishes and invertebrates and a few birds. The scanty vegetation on the rim of this island offers no shade, and if it were not for the brisk trade winds that blow continually, the heat of the tropical sun would be unbearable.

Field work was continued from May 3 to 10 on Swains Island (figs. 47, 48, 49), a small atoll about a mile and a half in diameter containing a fresh-water lake, around the shore of which I found a small species of goby. The members of the astronomical party, with whom I camped, were treated royally by Mr. Jennings, owner of the island, and by the natives, who brought us cocoanuts and other foods. They entertained us one evening with the siva-siva (a native dance).

My stay on Enderbury Island from May 14 to 20 was made most pleasant by the interest in natural history of James Kinney, a native Hawaiian employed at the radio station there. Through his aid I was able to catch several species of birds. Sooty terns were as abundant here as on Rose and Hull Islands. The shallow lagoon was not connected with the sea, and the absence of fish in it was sharply contrasted with their great abundance on the reef.

FIG. 45.—U.S.S. *Bushnell* off Canton Island. Length, 350 feet; displacement, 4,000 tons.

FIG. 46.—British radio station, right, and United States radio station, left, as seen from lagoon of Canton Island.

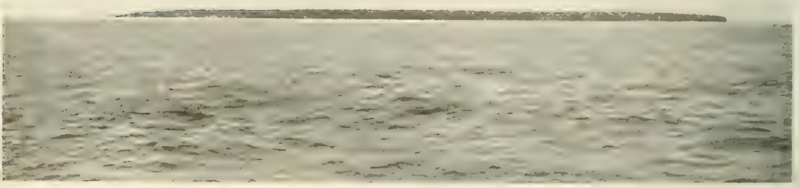

FIG. 47.—Swains Island, a tropical paradise, is about a mile and a half in diameter. The rim of this atoll, about 600 feet wide, keeps the sea out of Lake Namo, the latter occupying the center of the island.

FIG. 48.—To climb a cocoanut tree the feet are held together by a piece of rope and forced against the tree trunk by the weight of the climber. Swains Island.

FIG. 49.—The Swains Island polynesians bake in circular drums. Cocoanut shells are burned over coral stones until they are red hot. Iron plates are placed on top of them, and the drums are covered by other iron plates, on top of which are burned cocoanut shells giving heat from top and bottom.

During further visits to Canton Island on May 12 and 13 and again from May 23 to 27, I collected fishes and invertebrates in Canton Island lagoon, obtaining a rare trumpet fish and about 90 other kinds of fishes.

While the ship was at Pago Pago, June 2 to 8, I collected fishes with the help of Frank Taiga, native Polynesian; we took about a thousand specimens, representing over a hundred species, in one afternoon on a reef at Alofau, Tutuila Island.

Eleven days on Rose Atoll, June 11 to 21, resulted in the capture of over a hundred kinds of fishes, besides the collecting of specimens of lava rock, corals, mollusks, invertebrates, and several birds. In the tops of the Pisonia trees that formed a large grove on Rose Island were nesting boobies and frigate birds, and underneath on the ground sooty terns were nesting.

The fringing reef of Rose Atoll is dotted with big chunks of coral. That these boulders were once coral heads broken off the margin of the reef and rolled inward by big storms seems clear, as it was found upon examination that the corals making them up are not now in their normal growing positions, but lie in almost any direction as determined by the position in which the boulders came to rest.

My one day, June 27, on Tau Island was a great success, for in about 4 hours I was able to get about 800 fishes, which, when sorted, revealed over 90 species. Here I was amazed to see several little Polynesian boys dive in and catch a number of fish for me.

On Hull Island from July 7 to 18, I was fortunate in obtaining many fishes as the result of blasting with TNT by the Navy, both on the reef and in a big channel among coral heads. On this island, as on several other islands of the Phoenix group, may be found old stone ruins, some of which were left by the early Polynesians who visited these islands before their discovery by white men.

The coral atolls, such as Canton, Enderbury, Hull, Rose, and Swains, have fringing reefs from 200 to 500 feet wide, nearly flat and level, but with slightly elevated areas 1 or 2 feet higher near the outer margin where the waves break at low tide and cut parallel channels that extend inward as far as 150 feet, but averaging about 50 feet. When the reef is just awash, the waves break over its slightly elevated margins and the water flows out through the channels, surging up and down in them with great force, often making blow holes. The fringing coral reef is in some places overhanging, and at such places I could see down through the clear blue water of the channel for more than 50 feet underneath the margin of the reef.

FIG. 50.—Landing through the surf of Enderbury Island was precarious even on the calmest days.

FIG. 51.—The great force of the waves at certain places on the beaches of Hull Island piles the coral stones as high as 15 feet.

FIG. 52.—Sooty terns were very abundant on Hull Island. When disturbed about two-thirds of those on the nesting grounds flew into the air.

Managing a boat through the surf over a reef and landing on the beach of a coral island, such as Enderbury is attended with considerable danger even on the calmest days (fig. 50).

Storms break off portions of the outer edge of the reef and roll these chunks inward, some of them measuring 10 to 15 feet long, and 5 to 8 feet in width and height, and around the bases of these boulders occasionally occur small depressions filled with water. Pools left at low tide are uncommon on the coral reefs because of their almost complete drainage by channels.

The slope and height of the beach depends upon the force of the wave action (fig. 51). Gently sloping beaches, composed of coral gravel and sand, occur in protected areas, but those composed of large rubble are very steep because of the terrific wave action. Some islands have the conglomerate coral-shell rock (solidified beach coral-shell debris) exposed by wave action.

Fish life is abundant on the reef and in those lagoons actively connected with the sea by large channels. Spiny lobsters, crabs, and shellfish, mostly Tridacna, occur in numbers on the reefs. Practically all these marine animals are edible.

Many species of birds nest on the ground or in the low trees. The sooty tern, the most abundant bird on the coral atolls, lays its eggs on the ground in great numbers. If a small portion of the nesting area is cleared of eggs at night, the terns lay more the next day, and fresh eggs are thus made available. Their rookeries are easily located by the thousands of sooty terns flying about and uttering their call night and day. When disturbed, they fly about in such numbers that the sky seems filled with sooty terns (fig. 52). The tern eggs, when boiled or scrambled, are palatable, as I can personally testify after eating them at Enderbury Island.

On July 27 I was again at Pearl Harbor and spent the next few days examining fishes at the Bishop Museum, through the courtesy of the curator, E. H. Bryan. Leaving there August 4, I arrived in Washington August 18.

The expedition, besides offering me much worthwhile experience, resulted in the capture and preservation of about 14,000 fishes and many hundreds of specimens of mollusks, crustaceans, insects, echinoderms, and corals, as well as several lizards, plants, and bird skins.

HANCOCK EXPEDITION OF 1939 TO THE NORTH COAST OF SOUTH AMERICA

By WALDO L. SCHMITT
Curator, Division of Marine Invertebrates
U. S. National Museum

In the spring of 1939 Capt. G. Allan Hancock took his motor cruiser, the *Velero III,* into Atlantic waters for the first time, traveling along the north coast of South America as far as Trinidad, and back by way of Tobago and the Dutch Island of Curaçao. Through the kind invitation of Captain Hancock, I had the good fortune to accompany the expedition as representative of the Smithsonian Institution.

Outward bound from Cristobal we first visited the San Blas Indian country, putting in at Caledonia Bay in the early morning of April 3. The bay seemed immense, fringed with sand and coral beaches, overhung by graceful cocoanut palms, and studded with innumerable large and small islands. Some of the islands are green hills rising out of the bay; others are mere sand bars a few feet above high-water mark. The latter are favored by the San Blas as their village sites.

At some little distance from our anchorage, near the southern end of the bay and yet readily accessible by launch, were two sizable villages of the characteristic stave-and-thatch houses. During our visit to the farther of them not a woman or girl was to be seen, which is quite in keeping with the customs of tribes who have not had much intercourse with outsiders. Men and boys, the latter for the greater part with no clothing whatever, gathered closely around in order to gaze as curiously at us as we did at them. Near the center of the village was a large communal house with tiers of seats around a central square where were hung the hammocks of the leading men. The central area was open to the roof, but around it at second-story level was a balcony crowded with a great number of carved and painted wooden ceremonial figurines of various sizes from small dolls to images larger than the average man.

In an open dugout drawn up on shore was a considerable store of light brown meaty kernels that I concluded were used as food, though I could not make much out of the few words of apparent Spanish that the Indian who was standing near tried to articulate. Those

Fig. 53.—The *Velero III* at Caledonia Bay, Panama. Though still under the leadership and captaincy of Capt. G. Allan Hancock, the cruiser is now a part of the Hancock Foundation of the University of Southern California.

Fig. 54.—A South American *Robert E. Lee* on the Magdalena River, Colombia. This stern-wheeler is pushing two heavily laden barges ahead of her.

Fig. 55.—San Blas sailing canoe, Caledonia Bay. The San Blas Indians are great boatmen and splendid sailors. They seem more at home afloat than ashore.

FIG. 56.—San Blas village, Caledonia Bay, Panama.

FIG. 57.—Robinson Crusoe Land, Buccoo Bay, Tobago. Tropic clime, thatched shelter, cocoanut palms, beach of coral sand, and private yacht—what more could a man want?

FIG. 58.—One of the world's largest oil refineries, Lago Oil and Transport Company, Aruba, Netherlands West Indies.

that I brought back with me were determined by Paul Russell, of the Department of Agriculture, as a species of *Pachira.* The large seeds of one tree of this genus, *Pachira aquatica,* common in swamps along the Atlantic coast of Central America, are said to be roasted and eaten like chestnuts, but I do not know that such use of them has been ascribed to the San Blas Indians. Nevertheless, I feel certain that they do use them for food in some manner.

At Baranquilla, Colombia, our next major stop, an early morning visit was paid to the market, where specimens of the fish and crustaceans on sale were obtained for subsequent study. Between the ship's side and the dock a number of small fish and a host of tiny shrimp were dipped up with a hand net. Baranquilla is on the Magdalena River, one of the great rivers of the world, navigable for nearly a thousand miles from its mouth. Like the Amazon, its turbulent, muddy waters discolor the ocean for miles off the coast. It carries a tremendous water-borne traffic to and from the interior of the country. The steamers plying its waters are large stern-wheelers, usually pushing several heavily laden barges or scows ahead of them. They are strongly reminiscent of the days of showboats and steamboat races on the Mississippi.

Captain Hancock has installed some remarkably efficient dredging equipment on the *Velero III,* and so at all favorable opportunities large-scale dredging operations were undertaken. One of the better dredging grounds was found off Cape La Vela, Colombia.

During the 20-odd hours spent at St. Nicolas Bay, Aruba, we had very worth-while collecting at Punta Basora, well to the windward or east end of the island. To the leeward, along the south shore of Aruba, there has accumulated a great belt of tarry matter, either refinery residues or else the result of the pumping out of the numerous huge tankers that visit this tiny port day in and day out throughout the year. This has utterly ruined the fine collecting grounds that formerly existed on this side of the island. Here the Lago Oil and Transport Company maintains one of the world's largest refineries. Aruba is also known as the home of an endemic rattlesnake. These rattlers are of considerable concern to the oil company because of their habit of lying on the warm oil pipe lines at night. The native watchmen are so afraid of the snakes that it is with difficulty that the company succeeds in keeping its lines properly patrolled.

La Guaira, Venezuela, was our next port of call, and almost every one aboard took the opportunity of visiting Caracas, which lies back up in the mountains, 4,000 feet above sea level, and is reached by one of the most scenic, yet most tortuous, of well-paved highways. The

FIG. 59.—The dredge is up with a rich haul of Caribbean bottom life from off the coast of Venezuela. Captain Hancock, in officer's cap, stands in center foreground.

FIG. 60.—San Blas Indian with edible *Pachira* seeds set out to dry. To the right is a livestock pen.

FIG. 61.—Main street, Caledonia Bay. The native is entering the village's large communal house.

city is beautifully situated and contains many fine homes and parks. One of the show places is the Caracas Country Club, where we met, among other most hospitable people, Dr. Alfredo Jahn and Rudolf Dolge, President and Vice President of the Venezuelan Natural Science Society.

Between La Guaira and Port of Spain, Trinidad, a number of dredgings and shore collections were made at Tortuga, Cubagua, and Coche Islands. Boat dredging, shore collecting, and botanizing were undertaken at Port of Spain, and additional collections were made also on the windward side of the island at Manzanillo.

The famous pitch lake of Trinidad was an interesting sight. The level of the lake is definitely receding, which is no wonder, for the excavating seems never to stop. There is an almost constant stream of loaded cars clattering up the cable way to the asphalt refinery and empties coming back to be filled up again. The viscous mass of asphalt is still soft enough to receive good, deep impressions of your feet if you stand in one place any length of time.

One of the high lights of the cruise was our visit to Tobago. This is the Atlantic Robinson Crusoe Island. It is true that the exploits of Crusoe were largely those of Alexander Selkirk, who lived on Juan Fernandez, off the coast of Chile, but the locale of that world-famous story is the island of Tobago. It is a most beautiful place, and Buccoo Bay is claimed by some to have furnished Defoe with the material for his scenic descriptions. To reach Buccoo and its reef we first had to take an auto bus across the island from Scarborough, where the *Velero III* was anchored, and then make arrangements with a native fisherman to take us out in his boat, but both trip and collecting were well worth the effort.

Buccoo, at Tobago, was our last major collecting stop in the Atlantic, although some work was done during our 2-day stop at Willemstad, Curaçao, off Galera Point, Colombia, and again in Caledonia Bay, Panama. We arrived at Cristobal in the early evening of April 28, after 26 days on the Atlantic. The strong easterly trades blew almost without cessation throughout the trip. The monotonous regularity of it had us all on edge, but the Captain did not let the wind stand in the way of our scientific investigations. We had the great pleasure of Mrs. Hancock's company on this cruise. Not only did she wholeheartedly encourage our several endeavors, but she and the Captain also took an active part in our collecting forays.

Again the Institution is indebted to Captain Hancock for this opportunity to participate in another of his successful scientific expeditions.

GREENLAND EXPEDITION OF 1939

By CAPT. ROBERT A. BARTLETT
New York City

In the last week of April 1939 we began fitting out the *Morrissey* for her annual summer trip to the Arctic, in order to be ready to set sail before the end of June. Again Dr. Waldo L. Schmitt, Curator of Marine Invertebrates, United States National Museum, gave us a willing hand in supplying the necessary equipment to collect all kinds of plant and animal life. David C. Nutt, making his fourth voyage on the *Morrissey,* was in charge of the scientific collections and biological investigations.

Besides the wide range of material collected for the Smithsonian Institution, four musk ox calves were captured alive for the New York Zoological Garden. Extensive series of birds were collected for both the Cleveland Museum of Natural History and the New England Museum of Natural History in Boston. The collections obtained for the Boston museum are largely the result of the interest and enthusiasm displayed by John K. Howard, Jr., who made his first visit to the Arctic this year. Rupert Bartlett got together a splendid collection of flowering plants, his best of several seasons. Our surgeon, Dr. Walter Kemp, was of great assistance to the field collectors and in the troublesome matter of preserving our varied hauls of marine life.

For permission to collect all these things in Greenland we are indeed indebted to the Danish Government, and we are very grateful, too, for the permits given us by the Department of Natural Resources of Newfoundland to collect specimens of Newfoundland bird life.

Capt. J. F. Hellweg, U.S.N., Superintendent of the U. S. Naval Observatory, and the Hydrographic Office of the Navy kindly supplied us with necessary instruments, books, and charts. In return, we furnished them with detailed records of ice conditions and berg movements, surface temperatures, and meteorological data. These were forwarded direct to Washington by radio. Drift bottles were put overboard on many occasions.

Our complement on the *Morrissey* this summer included David Nutt, Dartmouth College, a veteran of three of my previous expeditions; John K. Howard, Jr., Groton School; Doron Warren, Lafayette

FIG. 62.—The *Morrissey* bowling along under a good 10-knot breeze.

FIG. 63.—Dr. Kemp emptying out the contents of the plankton net for preservation and study.

FIG. 64.—A huge tabular iceberg. Bergs of this type are more common in the Antarctic than in Arctic waters.

FIG. 65.—Close-up of a very large and picturesquely sculptured berg.

College; Eugene Munvies, Vanderbilt College; Holmes McClure, Hill School; Bob Schuette, Dartmouth College; Leo Silverstein, Dartmouth College; Rupert Bartlett, Memorial College, St. John's, Newfoundland; Sammy Bartlett, Methodist Academy, Brigus, Newfoundland; Reginald Wilcox, Hartford, Conn.; Donald Clark, New York; Arthur Manice, Trinity College; and Dr. Walter Kemp, Harvard University. Besides these able lads, I had my usual crew of Newfoundland fishermen and sealers, who thoroughly understand ice, weather, and the ways of the sea. Much of this valuable knowledge was soon imparted to the boys, and I know they have learned a number of things of use and profit to themselves.

Leaving City Island on June 26, we had a fine run to Brigus, Newfoundland. July 14 found us off Cape Farewell, Greenland, and working north toward Denmark Strait. During the afternoon of July 17, in latitude 63°42′ N., longitude 15°40′ W., we saw the most remarkable mirage I had ever witnessed in more than 40 years of Arctic service. It was a mirage of the coast of Iceland, with which I am well acquainted, raised in the sky and bearing 67° true. It appeared to be no more than 25 or 30 miles distant, though actually, from where we were plowing along through a smooth sea, it was more than 250 miles away. There can be no doubt of our position, as we had a good check on our instruments and chronometers. If I had been bound for Rejkjavik, Iceland, and had not been sure of my position, I would have expected to arrive within a few hours. The contours of the land and the snow-covered summit of the Snaefells Jökull of Iceland showed up with almost unbelievable clearness.[1]

In a moderate gale we made the ice; luckily, it was loose, and we were able to lie to in its welcome shelter until the next day, when the wind dropped and the sun came out, giving us our first glimpse of the Blosseville coast in all its cold majesty. We found the northern part of this coast free of ice. We steamed in back of Manby Peninsula on July 23 to spend our first day ashore in Greenland filling our tanks with the fine, clear water of the little streams tumbling down from the mountain tops. Here we collected our first specimens of Greenland plants and animals for this cruise. Rupert Bartlett, who went ashore, reported on his return that he had found a hot spring.

July 24, a gorgeous day, was spent cruising along the Liverpool coast. All hands stood in awe of the scenic splendor of the mountain spires emblazoned by the bright summer sun. Many little auks burgomaster gulls, and a few murre were seen along this shore.

[1] Dr. William H. Hobbs, of the University of Michigan, to whom I related my experience, was so impressed that he published a note about it in *Science*, Dec. 1, 1939.

FIG. 66.—The native reception committee comes out in full force to welcome the *Morrissey* and escort her into the harbor of Angmagssalik.

FIG. 67.—Three of the Angmagssalik queens of beauty.

Farther north the ice conditions became worse. The entire fiord region was closed. We were stopped 15 miles south of Shannon Island by solid ice to the north and west. A little later, however, we went around this, following north in the hope of being able to reach the Belgica Bank and use our otter trawl, but bad weather turned us back at latitude 77°15′ N.

About 10 days were spent exploring the Clavering Fiord region in search of the musk ox calves and other specimens. Whaleboat journeys to the bottom of Loch Fine and Grant's Fiord were made. Numerous bottom dredgings and plankton hauls produced valuable specimens of marine life. Many species of birds were encountered; especially abundant were the pink-footed geese, the Arctic terns, and the ringed plovers. We got a fine lot of photographs and motion pictures in this region.

Cruising south, we stopped for 2 days at Angmagssalik to visit the Eskimos and the Danish Settlement, good friends of our former trips to the east coast.

The unusually fine weather of August 25 permitted us to work in toward Cape Farewell and use our otter trawl in a region heretofore untouched. The day was a memorable one, with the sun so bright on the mountains looking down on us; outside lurked billowing banks of fog which slowly closed in as the net dragged along the bottom at a hundred fathoms. It was a grand haul, for among the wealth of marine life it contained there were five specimens of a very rare 10-armed starfish, *Crossaster squamatus*. Austin H. Clark, of the National Museum, tells me that heretofore only five specimens of this species have been known in the world and that they are all in European museums. The specimens which I collected, now in the National Museum at Washington, are the first in any American collection.

A party that went ashore on one of the small islands found it to be typically Labrador in appearance, with its many small ponds and blueberry and crowberry bushes. Four Brant geese, many northern phalaropes, and purple sandpipers were encountered.

On the voyage from Cape Farewell to Newfoundland plankton hauls were made every 4 hours, rain or shine, snow or blow.

We made the Newfoundland coast on September 1, stopping at Brigus for 2 days before following on to New York and Staten Island, where the little *Morrissey* is tied up for the winter. All hands returned in good health, our specimen boxes were brimful, and the musk ox calves in fine fettle. Already we have started laying our plans for next summer's voyage; one good trip begets another.

BUTTERFLIES OF VIRGINIA

By AUSTIN H. CLARK

Curator, Division of Echinoderms, U. S. National Museum

Very few butterflies are really rare, though many are seldom captured. If in any district you meet with a particular kind of butterfly only at long intervals, it usually means that the individuals you find are not really at home but have come from somewhere else not very far away.

Along the western border of Frederick County we had from time to time noted individuals of the silky blue (*Glaucopsyche lygdamus*), the Virginia white (*Pieris virginiensis*), and the Olympian marble (*Euchloë olympia*). The first two were so very scarce that we knew they were more or less strangers to the region, and the last was not very numerous.

In the spring, when these butterflies are flying, it is often windy, the wind coming from the west, so we figured that not far to the westward, in Hampshire County, W. Va., we ought to find all three of them in numbers. Visiting this region early in May, in company with Mr. and Mrs. Ernest L. Bell and Dr. Walter S. Hough, we found them all, as we had expected.

The little silky blue flies very fast and keeps very near the ground so that it is not easy to capture on the wing—and besides, you do not often see it. But we found that its food plant in this region is the Carolina vetch (*Vicia caroliniana*). If you simply stay near a patch of this plant one of these butterflies will come to it every few minutes. By this method you can in a short time gather all you wish. This is generally regarded as a rather scarce little butterfly, but we found it common enough.

The Virginia white we found in damp low woods near a stream. It has a languid flight and is by no means as energetic as the European cabbage white (*Pieris rapae*). It keeps always in the woods, whereas the cabbage white keeps to the open country. We did not find it very common; as all the individuals captured were worn and broken we judged that its season was almost over. Probably a week or two earlier it would have been more numerous.

The Olympian marble was very common on the higher portions of the hills and ridges. In fact, one or more were almost always in sight. On looking over the series of nearly 40 that we captured on

FIG. 68.—The diana fritillary (*Argynnis diana*), male, upper side. Spring Grove, Surry County, Va., June 15, 1938.

FIG. 69.—Same specimen as above, under side.

FIG. 70.—The silky blue (*Glaucopsyche lygdamus*). Left, male, upper side; center, male, under side; right, female, under side. Ice Mountain, W. Va., May 7, 1939. × 1½.

FIG. 71.—Left, Couper's blue (*Glaucopsyche lygdamus couperi*), male, under side; Charles Town, W. Va., April 25, 1900. Right, *Erora laeta,* under side; Mountain Lake, Va., June 23, 1938. × 1½.

FIG. 72.—Left, the Olympian marble (*Euchloë olympia*); Frederick County, Va., April 24, 1938. Right, western marble (*E. o. rosa*); Forks of Cacapon, W. Va., May 8, 1939.

FIG. 73.—Left, *Incisalia polios,* under side; Digby, N. S. × 1½. Right, the Palatka skipper (*Atrytone pilatka*), male; Miami, Fla.

the first day we found that most of them agreed with the western race, *rosa,* instead of with the typical eastern race we had expected to find, and which we had taken earlier in spring in the same region.

On examining the matter we found that early in spring when it is still cold the typical form, *olympia,* is on the wing. After it becomes hot the butterfly changes over to the western type of coloration. So in northwestern Virginia and in adjacent West Virginia you find first the usual eastern form and toward the end of the season the form characteristic of the region from Nebraska southward to Texas and New Mexico.

In June we visited the Dismal Swamp region in company with Mr. and Mrs. Jackson H. Boyd and John and Alexander Boyd of Southern Pines, N. C. On the return trip we found *Argynnis diana* in James City and Charles City Counties, from which it has not previously been reported. Early in July we revisited this region with Mr. and Mrs. Bell and obtained our first July record for the Virginia metalmark (*Nymphidia pumila*).

Toward the end of July we spent 10 days in Highland County, where we found the northern coral hairstreak (*Strymon titus titus*); elsewhere in Virginia we have found only the southern form (*S. t. mopsus*). We also found the diana fritillary (*Argynnis diana*) generally distributed throughout the county, though nowhere common.

In the middle of September we spent 2 days on Tangier Island in Chesapeake Bay. Here butterflies were not common. The little saltmarsh skipper (*Panoquina panoquin*), however, more than made up for the scarcity of other species, for it was abundant everywhere on the marshes.

Although we ourselves succeeded in capturing only a single butterfly new to the Virginia fauna, the northern coral hairstreak (*Strymon titus titus*), three others were added to the Virginia list by our friends. Prof. Lorus J. Milne and Mrs. Milne, of Randolph-Macon Woman's College, Lynchburg, gave us for the National Museum a fine specimen of *Erora laeta* which they obtained at Mountain Lake, Giles County. Carroll E. Wood, Jr., of Salem, presented the Museum with an excellent specimen of *Incisalia polios* from near Salem. Otto Buchholz, of Westfield, N. J., has been so kind as to inform us of his capture of the Palatka skipper (*Atrytone pilatka*) near Munden in Princess Anne County.

BOTANICAL EXPLORATION IN COLOMBIA

By ELLSWORTH P. KILLIP
Associate Curator, Division of Plants, U. S. National Museum

For a period of more than 20 years special study of the flora of Colombia has been carried on at the Smithsonian Institution, in the course of which four expeditions have been sent to that country. Three of these were made between 1917 and 1927 and were organized in collaboration with other institutions of the United States. The most recent field trip was made in 1939 and was sponsored jointly by the Instituto Botánico, of Bogotá, and the Smithsonian Institution.

The little-explored Pacific littoral, including the western slope of the Western Cordillera, was the principal objective of this trip. However, our plans called for spending a short time at the Instituto Botánico and for revisiting the Quindío region, in the Central Cordillera, where grow the celebrated wax palms.

Arriving at the Pacific port of Buenaventura February 1, I was soon joined by Dr. Hernando García y Barriga, of the Instituto. By a stroke of good fortune it was possible almost at once to visit Gorgona Island, a night's travel to the southwest of Buenaventura. The rich vegetation of this island was described as early as 1850, and very recently Dr. Robert Cushman Murphy, of the American Museum of Natural History, has given a fascinating account of its dense forests. Through the courtesy of Señor Marciel Lemos, Administrator of the Customs, we were invited to be passengers on the *Andagoya,* a government vessel which makes trips to the island at 8-month intervals to replace the acetylene cylinders at the lighthouse on nearby Gorgonilla Island. Here we anchored for 3 days while the crew laboriously lifted, by means of a pulley, the numerous cylinders up a nearly vertical cliff 300 feet high, carrying them along the crest to the lighthouse about a mile distant. Collecting along the shore and in the dense forest on the crest was exceptionally rich. Equally so was the interior of Gorgona itself, which we visited later while at anchor off the east coast.

Returning to Buenaventura, we next visited Bahía Solano, up the coast more than halfway to the Panamanian boundary. At the south shore of this bay an agricultural colony, Ciudad Mutis, has recently been established, which it is hoped will eventually develop into an important seaport. Though our time here unfortunately was limited

Fig. 74.—Mutis Patio in the Instituto Botanico.

Fig. 75.—Southern end of Gorgona Island from Gorgonilla.

FIG. 76.—Chontadura palms along the San Juan River.

FIG. 77.—Choco Indians on the San Juan River.

to 2 days, we were able to collect about 200 "numbers" in the dense forest which surrounds the colony to the south and east.

Our trip to the Pacific littoral being for the time terminated, we proceeded from Buenaventura to Cali, the principal city of the thriving Cauca Valley. Here arrangements had been made by officials of the Department of El Valle for us to use as headquarters the thoroughly up-to-date School of Tropical Agriculture, one of several agricultural schools established in Colombia in recent years. Excursions were made to two points in the Western Cordillera during this stay, one to San Antonio, at the crest of the Divide, the other to Yanaconas. It was a pleasure to have as a guide to San Antonio Mrs. Edith Dryander, whose specimens, obtained mainly from the Cali region and sent to the Botanisches Museum at Berlin, have been the types of many new species.

Dr. García and I made the trip from Cali to Bogotá by plane in an hour and a half, crossing the Central Cordillera, with its magnificent snow-topped peaks of Tolima and Ruiz, and the Magdalena Valley. Bogotá, situated on a plateau in the Eastern Cordillera at an altitude of about 9,600 feet, was my general headquarters for the greater part of March, and I had ample opportunity of becoming acquainted with the interesting suburb, University City, to which the National University is being gradually transferred. The dominant building is the Botanical Institute, in which are housed the National Herbarium and, for the present, the zoological and entomological collections of the nation. The establishment of this important scientific institution has been due largely to the energy and enthusiasm of Dr. Enrique Pérez Arbeláez, chief botanist of Colombia, who has been amply supported by the three recent National Administrations. Not only is the botanical equipment here most adequate, but the director has assembled on his staff many of the leading young botanists of the country.

On reaching Bogotá on March 7, I found that A. H. G. Alston, of the British Museum (Natural History), had just arrived from Caracas, having driven over the remarkable trans-Andean Highway. We decided to join forces for the next few weeks, making use of his truck to visit regions made easily accessible by the construction of good roads in recent years. Our main joint excursion was to Villavicencio, the gateway to the vast lowlands of eastern Colombia, about a 6-hour drive from Bogotá. Daily side-trips from this base gave an opportunity of collecting on the grassy llanos, in the palm jungles, and along the banks of the Guatiquía and Ocoa Rivers.

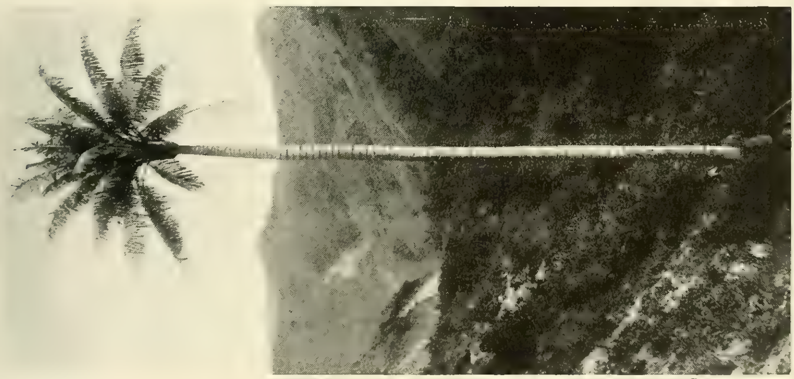

Fig. 78.—The wax palm of the eastern Quindio (*Ceroxylon andicola*).

Fig. 79.—A species of *Puya*, a striking plant of the Paramo de Guasca.

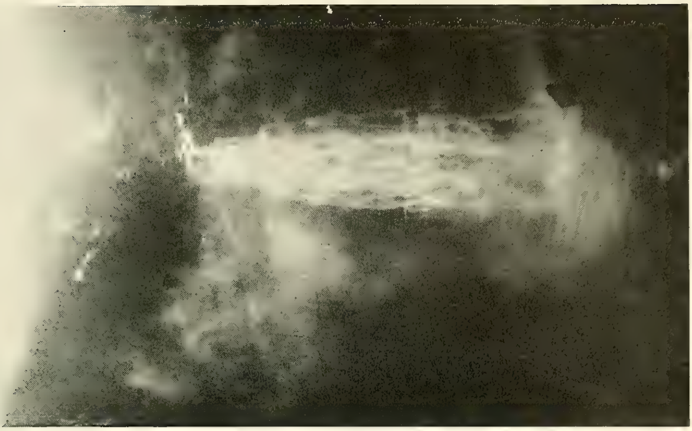

Fig. 80.—Tequendama Falls.

On the return trip from Bogotá to Cali a 2-day stop was made at Cajamarca, on the Quindío Highway, east of the Divide, in order to make a special study of the wax palms and to collect their fruit. This highway is situated a few miles south of the historic Quindío Trail, along which traveled Humboldt and Bonpland, Karsten, André, and other botanical explorers who have given detailed accounts of this magnificent palm.

Accompanied by two members of the faculty of the Cali Agricultural School, Drs. Dussán and Gómez, Mr. Alston and I spent the first few days of April in the Digua Valley, on the Pacific side of the Western Cordillera, through which a highway is being constructed to connect the Cauca Valley with Buenaventura. Like most of the Pacific slope, this valley is densely forested, and several hundred specimens were collected in the course of 4 days.

The final 3 weeks of my trip was spent in the interior of the Chocó, that vast, forested region extending from the Dagua Valley to the Panama border. A cordial invitation to visit the scene of operations of the Compañía Minera Chocó Pacífico along the upper San Juan River was extended to me by the officers of the company at New York. Transportation up the San Juan was arranged by the company's representative at Buenaventura, G. W. Bylander, who throughout my stay at this port had given me highly appreciated assistance. I had planned to explore the Chocó at the beginning of my trip, but abnormally low water had made boat travel difficult. Even in April the progress of the river steamer was slow, and we were obliged to wait 2 days at a native village before sufficient rainfall permitted our reaching Bebedó, the terminal of the Buenaventura boats. From here to Andagoya, the company's headquarters at the junction of the Condoto and San Juan Rivers, transportation was by launch.

Andagoya proved an ideal base from which to make botanical collections, and for the many courtesies received there I am deeply indebted to the manager, F. M. Estes, and the assistant manager, F. D. Bradbury. The company, which is engaged in dredging for platinum and gold, maintains smaller camps at various points along the upper San Juan and its tributaries, and to these I made frequent visits.

During the course of the present exploration nearly 2,700 "numbers" were collected, represented by about 11,000 specimens. A complete set has been deposited in the United States National Herbarium, and a nearly complete one at the Instituto Botánico. In this collection there are more than 300 numbers of ferns and more than 100 numbers each of orchids, aroids, grasses, and peppers. The work of identifying the material has been begun.

ANTHROPOLOGICAL STUDIES IN ENGLAND, RUSSIA, SIBERIA, AND FRANCE, 1939

By ALEŠ HRDLIČKA

Curator, Division of Physical Anthropology, U. S. National Museum

On April 15, 1939, the writer left New York on an anthropological trip to Europe, with particular emphasis on studies in Russia and Siberia. The main objects of the trip were: In London to see the remains of early man from Palestine, and also whatever Siberian skeletal material there might be in the museums of that city. In France the main purpose was to see the newly established Museum of Man in Paris. In Russia and Siberia the chief objective was to examine such skeletal and cultural materials from Siberia as might have a bearing on the problem of Asiatic-American connections.

Throughout the writer's stay in England and in the U.S.S.R. he received the most cordial and effective cooperation from the scientists and authorities of those countries, as well as from our own official representatives there. It would be impracticable to mention here the names of all those who were of assistance; but in England special thanks are due Sir Arthur Keith and Franklin C. Gowen, the Second Secretary of our Embassy, and in Russia the VOKS (Association for Cultural Relations), the Intourist, and the academicians, directors, and staffs of the Anthropological Institute in Leningrad and of the Anthropological Institute in Moscow; and the heads and members of the staff of the University and Museum at Irkutsk, Siberia.

The main part of the trip was in the U.S.S.R., where the stay was divided between Leningrad, Moscow, and Irkutsk. In the anthropological institutes and museums of these cities the writer found exceedingly rich and valuable materials from Siberia, all of which he was allowed to utilize freely.

The examinations in Leningrad were carried on in the new Anthropological Institute and Museum, which is housed in one of the most historic buildings in Russia—the Kunst-Kamera, founded by Peter the Great and still preserving many of the specimens that he brought from Holland. The Museum has a very large and valuable collection of human crania and skeletons, including important series of skulls of the Chukchi and other Siberian peoples. In the Anthropological Institute of the Moscow University there is another huge cranial and skeletal collection, including other important series of Siberian materials. Finally, at the Irkutsk Museum there was

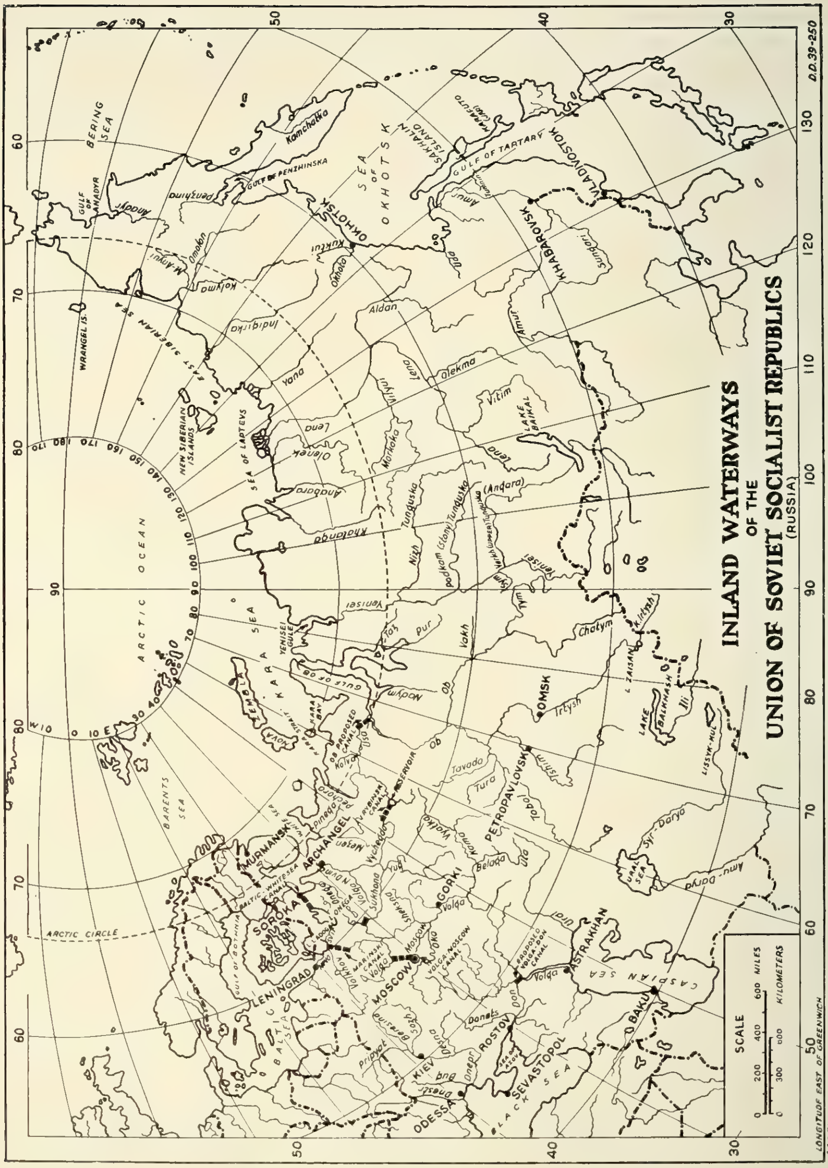

Fig. 81.—Map of the U.S.S.R., published by the United States Department of Commerce.

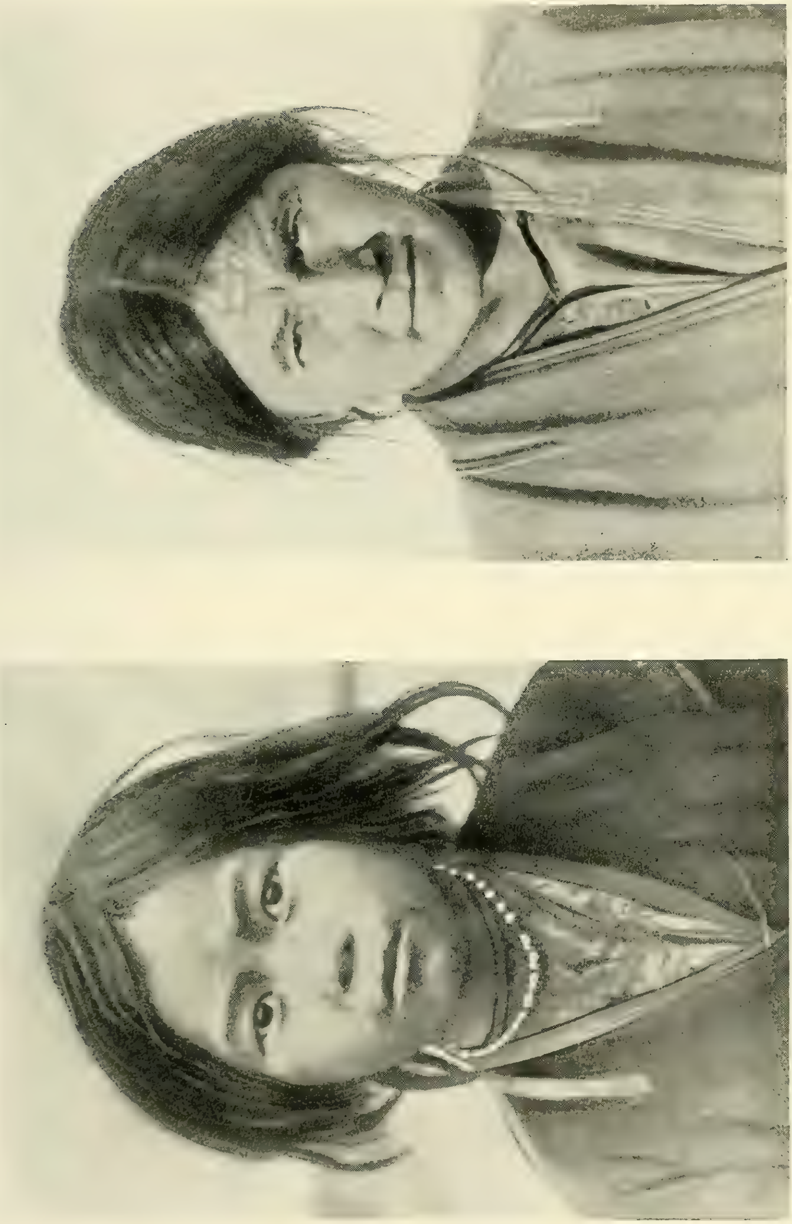

FIG. 82.—Keti, Yenisei Ostiaks. Photographs from the Anthropological Institute, University of Moscow.

Fig. 83.—Keti, Yenisei Ostiaks. Photographs from the Anthropological Institute, University of Moscow.

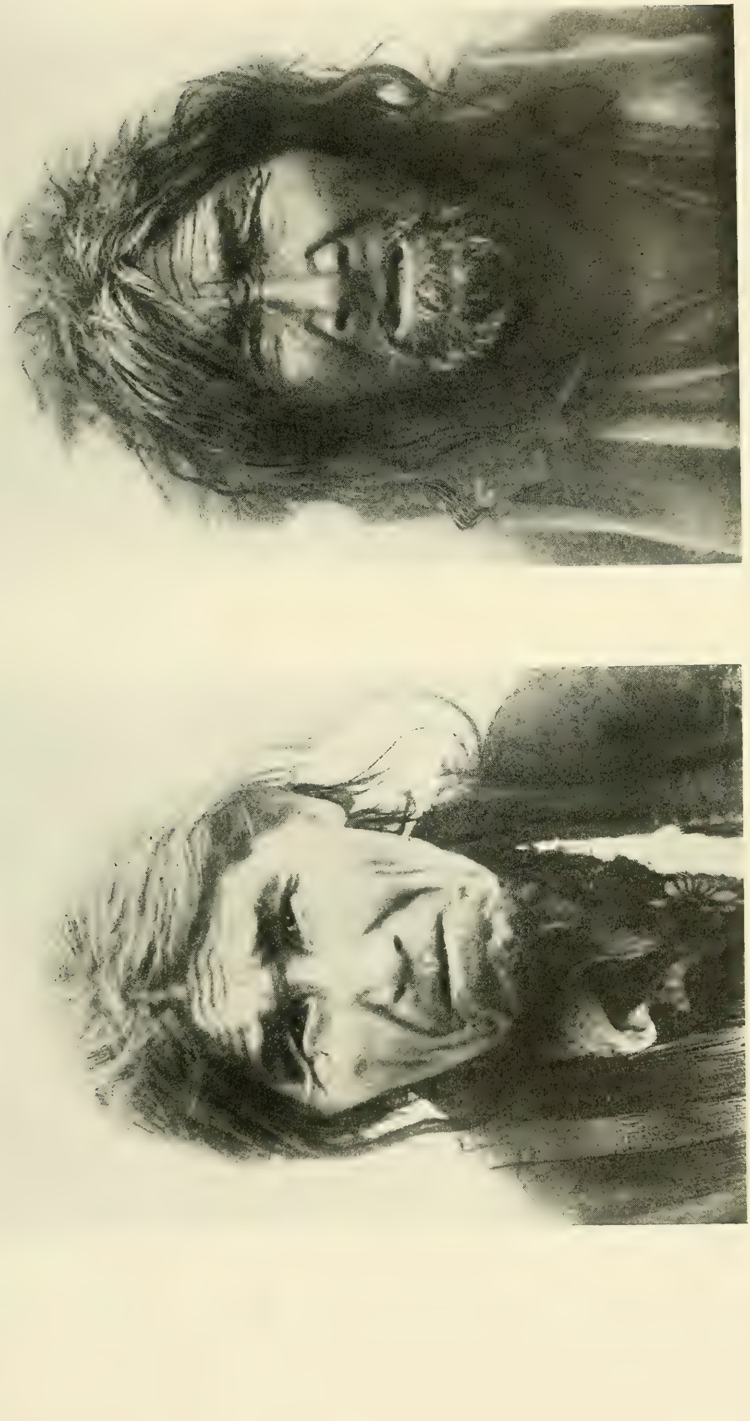

Fig. 84.—Keti, Yenisei Ostiaks. Photographs from the Anthropological Institute, University of Moscow.

found a large and very important collection of neolithic skeletal remains from the Angara River and Baikal Lake regions. Here also the writer was enabled to make three highly instructive trips along the Angara to paleolithic and neolithic sites, some of which were then being excavated by Russian scientists.

The total number of Siberian crania examined and measured by the writer on this trip was 606. This includes large and particularly interesting series of the Chukchi, Ostiaks, Tungus, and the neolithics of the Irkutsk region. It will, of course, take time to elaborate the data, but it may be said at once that the examinations showed unmistakable relations between the Chukchi and the American Eskimo, between the Siberian and the American brachycranic strains, and between the Siberian neolithics and the Shoshonean-Californian-Algonquin cranial types of America. In addition to this, the neolithic archeological materials of Siberia were found to show many close similarities to the archeological remains of the Aleutian Islands, Alaska, and other parts of the New World.

The writer also was given, for the United States National Museum, at both the Leningrad and the Moscow Anthropological Institutes and at the Institute of the Peoples of the Far North (Leningrad), series of portraits of individuals from different Siberian tribes whose physiognomies closely resemble those of American Indians.

The writer had the further privilege, partly at Leningrad and partly at Moscow, of seeing the skull, remains of bones, and associated cultural materials of a Neanderthal child from Uzbekistan, in Central Asia. These were shown him by Dr. A. Okladnikov, the discoverer, and by Professor Plissetzky, under whose direction the specimens were restored. This is a find of outstanding anthropological importance, and the skull, lower jaw and teeth are in excellent condition. The first cast of the skull was kindly promised by Professor Plissetzky, the director of the Moscow Anthropological Institute, to the United States National Museum.

Still another favor was obtained by the writer at the anatomical department at the Irkutsk University. This consisted of the exchange of one of the Indian-like neolithic crania from the Angara region for some American specimens.

A very gratifying observation in the Soviet Union was that archeological, ethnographical, and other anthropological research, both in the field and in the institutions, shows everywhere a vigorous revival.

The new Museum of Man at Paris, was found to be a huge and beautifully furnished establishment, occupying a prominent place on the site of the former Trocadero.

FURTHER EXCAVATIONS AT THE INDIAN VILLAGE SITE OF PATAWOMEKE (POTOMAC)

By T. D. STEWART
Associate Curator, Division of Physical Anthropology
U. S. National Museum

The systematic excavations carried on last year at the site of the Indian village visited by Capt. John Smith in the summer of 1608 and described by him under the name of Patawomeke, indicated that it had been a stockaded village. Among the details of the town plan that remained undiscovered at the close of the 1938 season were the main entrances, the location of the dwellings, and the manner of their construction. The cultural objects obtained during this work, as well as previously by Judge Graham, showed considerable uniformity, and thereby suggested a relatively short occupancy of the site; nothing thus far gave indication of the presence here of cultural elements differing from those apparent on the surface. Nevertheless, a further development of the town plan in itself was deemed of sufficient importance for continuing the investigation in 1939. For permission to excavate further on the site I am indebted to J. L. Pratt, of Fredericksburg, Va., and James Ashby, of Stafford, Va.

In order that the work might be carried on more intensively, the arrangement whereby we commuted from Washington was discontinued, and a camp was set up at the site. Additional funds permitted me to employ as assistants Robert Ladd and James Gillis, Jr., both of Washington, and to reemploy two local laborers. On June 15 two tents were pitched on the bluff overlooking the broad expanse of water where Potomac Creek enters the Potomac River. Shade, and unfortunately also fruit—which in turn attracted flies—was supplied by mulberry trees; water was obtained from the fine spring that presumably supplied the Indian village in its day; and supplies were transported with generous local help from Brooke, 7 miles away. One of the more appreciated assets of the location was the good swimming afforded by the river. Under these pleasant living conditions, the work was carried on until July 24, 1939.

The camp site also proved to be attractive to a Carolina wren, which insisted in trying to build a nest in a retracted tent flap and in the author's bed. In the latter place, however, the mosquito netting eventually served as a trap that discouraged her further efforts in this location.

Fig. 85.—Extending a trench eastward. Two laborers remove the topsoil while Mr. Gillis cleans the surface of the hardpan with a trowel. The camp is seen in the distance on the bluff overlooking Potomac Creek.

Fig. 86.—A cleared area showing two concentric rows of post holes and several shallow trenches. This feature was encountered at the northern periphery of the village site.

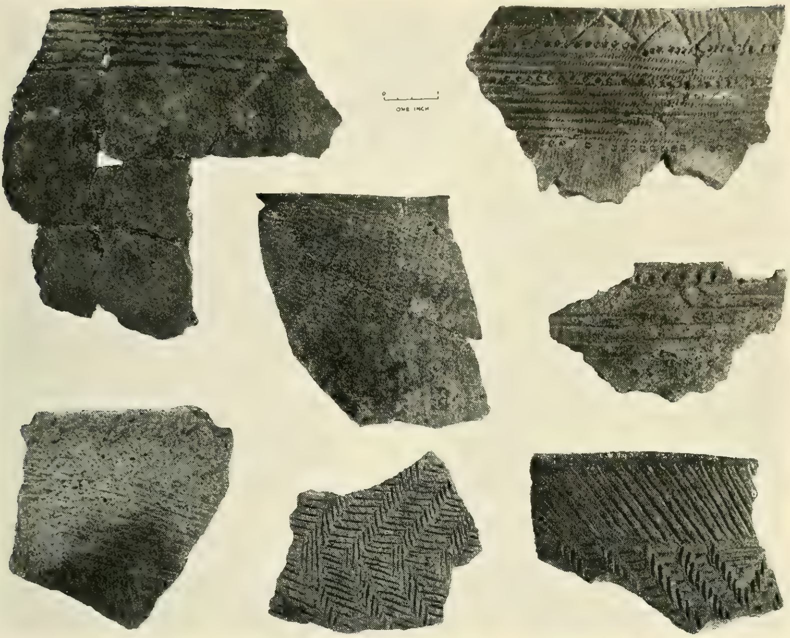

FIG. 87.—The two sherds at the top are typical of the cord-marked, grit-tempered variety prevailing at Patawomeke. The others, showing basketry impressions and incised line decoration (shell-tempered), came from a deep pit on the western side of the site.

FIG. 88.—Careful excavation of the ossuary revealed individual bodies arranged at right angles to one another in two layers. Note the completely articulated hand on the far side. In the case of this skeleton also the lower leg has been flexed forward unnaturally at the knee.

Constant presence at the site enabled us to employ a somewhat different technique from that used last year. Trenches 10 feet broad were extended across undisturbed parts of the site. This increased exposure, in contrast to the previous short 5-foot trenches, clarified the picture considerably. The initial trenches were run in the field to the east that had been under cultivation last season. Here we had hoped to find an entrance to the stockade, but were disappointed. As elsewhere about the site, the post holes are so numerous, presumably as a result of replacements and relocations of the original wooden structures, that the details are obscured. Some time was devoted also to trenching the accumulated refuse along the bluff overlooking the creek. In places these deposits reach 4 feet in depth but give evidence of having received accretions from the plow.

Attention was distracted from these features toward the close of the season by two important finds of a different nature: A deep pit containing a type of pottery unlike that prevailing on the surface, and an ossuary. The finding of the ossuary offered us the opportunity to expose the bones from above in order to show their arrangement. Circumstances usually do not allow time for this procedure. In the present case we succeeded in making a good record of about one-third of the burial pit before heavy and prolonged rains interrupted.

As the accompanying photograph (fig. 88) shows, individual bodies, still somewhat articulated, can be distinguished in this ossuary. A typical method of contracting the body appears to have been that in which the lower legs were flexed forward unnaturally at the knees so that the feet came to touch the abdomen. Two other features of the ossuary are of interest: 1, at one place there was a mass of charred bones, the remain perhaps of a deliberate cremation or sacrifice; 2, in connection with some of the skeletons there were great numbers of shell beads, and in one of these cases the largest beads had been placed within the skull, obviously at the time of burial.

As regards the strange type of pottery (see fig. 87), it is characterized by shell tempering, basketry impression, and line decoration in contrast to the grit tempering and cord marking of the prevailing type. The full significance of this find, aside from probable cultural succession, is not yet apparent. Pottery of this general type occurs along the Rappahannock River and in nearby Maryland.

It was necessary to discontinue the work on the above-mentioned date in order that the writer might reach Mexico City in time to attend the International Congress of Americanists, meeting there August 5 to 15, to which he had been appointed a delegate representing the United States Government.

ARCHEOLOGICAL EXPLORATIONS IN WESTERN KANSAS

By WALDO R. WEDEL
Assistant Curator, Division of Archeology, U. S. National Museum

During the closing decades of the seventeenth century, when the Spanish were reconquering the New Mexico region after the Pueblo revolt of 1680, discontented Indian groups on various occasions fled east and northeast into the buffalo plains seeking refuge among the Apaches. Though such flights were never of sufficient duration and magnitude to leave a marked impression on the alien peoples thus contacted, the fact that they did take place is of considerable interest to students of Plains prehistory. It raises the hope that datable antiquities of Southwestern type may eventually be found in direct association with remains of recognized Plains cultures. Through such association a clearer perspective might be imparted to the sequence of culture types postulated for the central Great Plains.

To determine, first, the extent of Puebloan influences in western Kansas, and second, the prospects for injecting time perspective into the earlier archeological history of the region, the writer extended into the High Plains an archeological survey begun in 1937. A month was spent in and near Scott County State Park, lying in the picturesque bluff-lined Beaver Creek valley, which contrasts most strikingly with the flat wind-swept and drought-ridden surrounding uplands (fig. 89). Traces of a seven-room pueblo ruin opened by Williston and Martin in 1898 were relocated. Middens yielded potsherds and artifacts of stone, bone, and horn, as well as rare objects of copper, iron, and glass. Charred maize, and squash or gourd rinds indicate horticulture, but quantities of animal bones suggest that subsistence was primarily by hunting. Contrary to expectations, Puebloan influences were almost negligible. Aside from the stone-walled ruin and nearby pre-white irrigation ditches there was a bare handful of sherds, some painted, and a few incised clay pipe fragments presumably attributable to late Southwestern stimulus. Numerous bell-shaped roasting pits and large irregular trash pits, as also the great bulk of artifacts recovered, show close relationship to sites of the protohistoric Dismal River culture of southwestern Nebraska. No houses of indigenous type were found. Whatever the relationship between these remains and the Pueblo structure, it is an interesting

FIG. 89.—Looking south up the Beaver Valley in Scott County State Park, Kans. Arrow points to El Quartelejo Monument and site of excavations.

FIG. 90.—Excavating a prehistoric burial ground near Scott County State Park.

FIG. 91.—Looking southeast across stratified village site on Salt Creek, Lane County, Kans. Expedition camp and a large spring concealed by trees at right of view.

FIG. 92.—Two prehistoric Upper Republican pit houses on Salt Creek. Each was circular in outline and originally had four central posts.

historical fact that in early contact times the western Plains were inhabited by Apache and Comanche bands, some of whom appear to have followed a semihorticultural mode of life.

Just outside the north entrance to the park a small burial ground, probably much older than the above remains, yielded two long-headed skeletons and several secondary (or disturbed ?) interments (fig. 90). With the skeletons were broken tortoise shells, tubular bone beads, and chipped flints, including one heavy-stemmed arrowpoint of Woodland type. Persistent search failed to disclose any evidence of an associated village or camp site.

About 20 miles east, on Salt Creek in Lane County, remains of different type were found. On and just below the surface of one site (fig. 91) were materials attributable to the Upper Republican culture of southern Nebraska. Two small pit houses, each with four center posts, were worked out (fig. 92). Along with shallow middens nearby, they yielded typical pottery, arrowpoints, a bone fishhook, etc., but no direct proof of horticulture. Separated from this deposit by a barren stratum up to a foot thick was a second cultural layer. From this came thick cord-roughened sherds and large-stemmed arrowpoints markedly unlike the top layer materials. This second horizon, evidently linked with some Plains Woodland manifestation, had been intruded by both pit houses. Beneath one of the latter, inclusive in the Woodland horizon, was a rocker-marked sherd similar to those found in 1937 at Hopewellian village sites near Kansas City. Lack of time precluded investigation of what may be a third cultural horizon underlying both of the above. Local collectors report the finding of Pawnee as well as of shell-tempered sherds, together with copper, glass beads, and catlinite on the wind-eroded surface. Two other sites tested in Lane County evidenced a similar stratification of Upper Republican over Woodland remains. Because of the limited occurrence of permanent springs in the High Plains and the resultant repeated use of desirable locations by successive peoples, I suspect still others could be found.

Tentatively summarized, these researches seem to show that in Lane and Scott Counties there were at least two groups of prehistoric pottery-making peoples. On stratigraphic grounds those bearing a Woodland culture preceded others with Upper Republican affiliations; neither appears to have been in contact with Southwestern peoples. Still later, in protohistoric times, a third complex assignable to the Dismal River culture, occupied the area. This sequence parallels that in western Nebraska and adds materially to the geographic range of the cultures involved.

EXCAVATIONS AT THE LINDENMEIER SITE CONTRIBUTE NEW INFORMATION ON THE FOLSOM COMPLEX

By FRANK H. H. ROBERTS, JR.
Archeologist, Bureau of American Ethnology

Continuance of excavations at the Lindenmeier site in northern Colorado and careful exploration of the deeply gullied terrain for many miles in all directions in an effort to obtain additional information and further traces of Folsom man, the nomadic hunter who tarried in that district during the closing days of the last ice age, constituted the activities of one Bureau of American Ethnology-Smithsonian Institution field party in the summer of 1939. The digging produced new and augmenting data, but the reconnaissance failed to locate more than sporadic traces of former occupancy, none comparing either in extent or quality of evidence with the main site.

Previous investigations established the fact that the Lindenmeier site was a former camping place occupied when glaciers still lingered in the mountains; when the climate was cooler and more moist; when species of bison, camel, and mammoth, animals now extinct, roamed the western plains; and when the topography differed from that of today. The earlier digging revealed that what now appears as a terrace was originally part of a valley, the bottom dotted with meadows, marshes, and bogs furnishing food, water, and wallowing places for the animals, and the gently inclined lower slopes providing a suitable resting spot for the aboriginal hunters. In addition to the game that served to satisfy the requirements for food and probably for the materials needed for tents and such clothing as was worn, the region also supplied stone in the form of nodules, weathering from surrounding deposits, from which to fashion tools. That full advantage was taken of these resources is shown by the numerous scattered assemblages with implements in association with cut, split, and burned bones, and concentrations of chipper's debris, the minute stone splinters and larger unused flakes resulting from the manufacture of various kinds of articles. These materials are found along the old level of occupation several feet below the present surface.

The 1939 excavations consisted of the removal of the overburden, ranging from 3½ to 5½ feet in thickness, from some 1,540 square feet of the camp area, the sinking of 10 test pits in unsampled portions of the site, and making examinations of outcroppings of the

Fig. 93.—General view of Lindenmeier site. Arrow points to main excavations. Light spots on ground to right above upper ravine bank indicate digging of previous seasons.

Fig. 94.—Portion of the main excavations of the 1939 season.

FIG. 95.—Trench extending from main pit shows upward slant of occupation level and demonstrates former existence of bordering ridge.

FIG. 96.—Portion of main pit showing bone scraps and section of bison jaw in position below dark soil zone.

archeological stratum in the banks of a deep ravine that traverses part of the old valley bottom (fig. 93). Exposure of the former surface of occupation started from the side of a test trench dug in 1938 and continued up, down, and along the slope (fig. 94). The layers of earth in the overlying deposits at this part of the site hold so consistent a level in relation to the course of the old valley and have such a gradual slant in the other direction that a narrow trench was cut through from the main excavation to the edge of the terrace to ascertain the nature of their termination. They end on the surface a few feet from the escarpment and clearly show that they formerly continued on the same gradient (fig. 95), for an undeterminable distance. The feature is significant because it augments and emphasizes previous indications that the valley once was bordered by a ridge long since eroded away. Some of the material was swept down across the site, forming the layers above the archeological horizon, but the bulk of it has been carried away in the opposite direction, thus producing the terracelike character of the formation.

The thick, dark-colored stratum apparent in the photographs just above the floor of the excavation is a soil zone produced by lush vegetation during a period of heavy precipitation when growing conditions were more favorable than those of recent times. The layer is important because it was the means of correlating the site with geologic phenomena attributable to the waning of the Glacial period. The artifacts and bones occur along the upper surface and in the lighter-colored stratum below, some projecting into the zone above (fig. 96). The light layer consists of a mixture of wind-blown sand and decomposed material from the top of the tufaceous clay deposit underlying the whole area. The stratum is evidence for a dry and windy era associated with a minor oscillation in the last ice sheet and establishes a slightly earlier occupation than previously supposed. The positions of the artifacts and bones show inhabitation before the onset of the wet cycle and that tenancy persisted for a time after its inception but did not continue throughout its duration. The climate may have become too damp, possibly somewhat cooler as well, and as a consequence the animals and people moved on, probably farther south along the edge of the Plains, where traces of their former presence appear in several places.

The excavated area yielded more specimens than any of comparable size yet dug. The artifacts comprise typically fluted Folsom points, fluted knives, knives made from channel flakes removed from the faces of the points, other kinds of flake knives, a large variety of scrapers including several forms of the spokeshave type, flakes with

FIG. 97.—Workman pointing to bone bead in situ, pieces of bison bones partially uncovered. Inset shows two forms of beads. Upper specimen decorated with incised lines.

FIG. 98.—Test excavations in ravine bank. Standing figure in central foreground is on old surface of occupation.

graver's points, large choppers and hand hammers, pigments in the form of hematite and red and yellow ochers, bone punches and awls, pieces of decorated bone of unknown function, and tubular bone beads. An interesting feature in the material from this portion of the site is the large number of channel flakes and the quantity of chipper's debris. These suggest proximity to the place where points were made, probably to the actual habitation area of some of the group. There are several new types of knives and scrapers in the collection and the beads (fig. 97) are the first to be found in the Folsom complex. They were made from shafts from long bones. Unfortunately, the process of manufacture removed the criteria for identification, but they seem to be rabbit and bird. One of the specimens is decorated with a series of short, parallel lines cut into its surface.

Because most of the bone material of the 1939 season is the residue from meals, it is too scrappy to permit recognition of all of the animals represented. There is no question, however, of the presence of bison, antelope, deer, and rabbit. The basal portion of one bison skull was found with the horn cores still intact. The distance between the tips of the cores is 36 inches (914.4 mm.). This measurement, as well as the size and contour of the cores, shows the animal was one of the extinct species. Modern buffalo skulls from this general area range from 23 to 24 inches (584.2 to 609.6 mm.) between the tips of the cores. The older form was also much larger in all other respects.

The digging in the ravine bank, across from the main excavations, demonstrated that the horizon was the same although more deeply buried (fig. 98). The 20 feet of overburden is due to the fact that here the surface of occupation was farther down the slope toward the valley bottom and the deposition of eroded debris was greater than that at higher levels. The material was still on the south slope of the old valley, however, as has been the case in all previous finds. As the dark soil zone approaches the old bottom it becomes thicker and takes on the appearance of silt, such as occurs in bogs and meadows. Bone fragments found there are better preserved than those from higher up the slope. This condition is attributable to their having fallen into muck where they were sealed from the air and other agents contributing to rapid disintegration. The various test pits indicated the location of other concentrations of archeological material and helped to delimit the area of occupation.

The 1939 season, like its predecessors, failed to produce any human bones, and the physical nature of Folsom man is still unknown. There is no satisfactory explanation for the lack of skeletal material. It probably is present and simply has not been found in the digging.

A FURTHER QUEST FOR IROQUOIS MEDICINES

By WILLIAM N. FENTON
Associate Anthropologist, Bureau of American Ethnology

During several seasons of ethnological field work among the Seneca Indians of the western part of New York State for Yale University, and while teaching at the Allegany School of Natural History in 1938, I collected plants which the Senecas employ in their medicines. This information will fit into a comprehensive work on Iroquois medicines for which the late F. W. Waugh, of the National Museum of Canada, began assembling materials in 1912. This year it seemed advisable to widen our horizon to include other Iroquois reservations in New York and Canada. Waugh had worked some of them, and we hoped that an informant would be alive here and there to review his notes. Before setting out for the field we had completed a paper on suicide, and since we had found cases of lovelorn Iroquois women poisoning themselves with waterhemlock when their husbands deserted them, we were naturally on the alert for new cases. The plant had been mentioned as early as 1632 by Father Sagard among the Hurons, and we wondered whether the modern Mohawks and Hurons could tell us more about the "fatal root" which the Jesuits spelled *Andachienrra* (fig. 99).

With these rather melancholy objectives in mind we commenced field work on the Allegany Reservation at Salamanca, N. Y., in early July. Mrs. Fenton and the writer's sister, Miss Frances E. Fenton, a botanist, accompanied the expedition. Finding that Josephine Jimmerson, a herbalist at Shongo, had devoted most of her 77 years to midwifery so that childbirth interested her more than suicide, we commenced recording experiences in another activity borderlining medicinal practice. Childbirth proved a fertile line of inquiry during the summer.

We next moved down river to Cornplanter Reservation below the Pennsylvania State line. At "Burnt-house," the site of Cornplanter's village about 1800, we worked with two of his descendants, Charles Gordon and Harvey Jacobs, who still occupy the small grant on the west bank of the Alleghany River above Kinzua, "fish-on-spear." Jacobs learned his medicines from his grandmothers, who showed him the plants while going through the bushes berrying. Although his approach to therapeutics is fundamentally Seneca, years of trading herbs and peddling remedies among the whites of surrounding towns has earned him the title of "Indian doctor," which he has endeavored

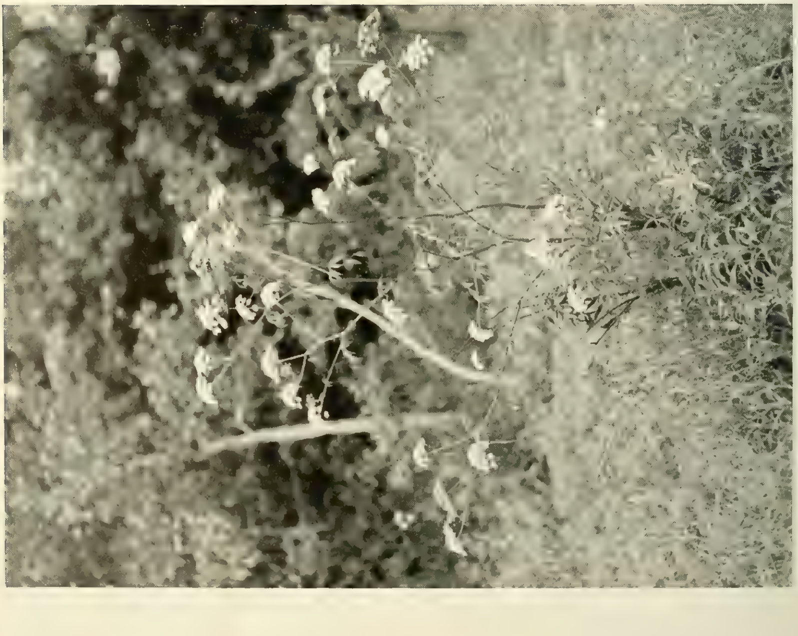

FIG. 99.—Waterhemlock, *Cicuta maculata* L., or "White Feather" to the Mohawks; source of the "fatal root" for suicide.

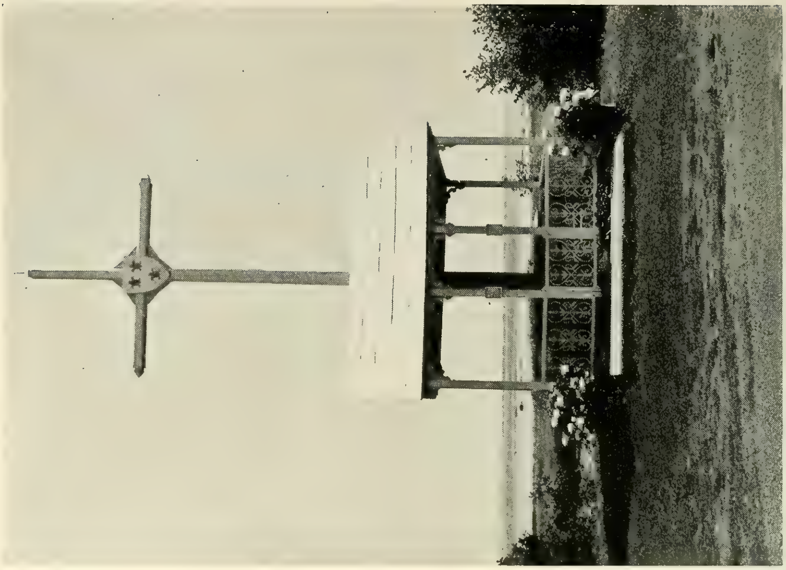

FIG. 100.—Shrine of Kateri Tekakwitha, Ste. Catherine de la Prairie, P. Q.

FIG. 101.—Kate Debeau, Mohawk herbalist and midwife of Caughnawaga.

FIG. 102.—Jemima Gibson, Cayuga of Grand River, offering tobacco beside the first plant of lobelia and taking the second home as a love medicine.

to justify by reading the "doctor books"; consequently, he speaks the professional jargon of two cultures. By agreeing to concentrate on the older household medicines, we felt surer that we were dealing with Indian culture.

We visited two Mohawk reservations on the St. Lawrence, St. Regis on the United States-Canadian border, and Caughnawaga ("at-the-rapids") above Montreal. Three hundred years of Jesuit teaching has left little but the language. The family of Noah La France, representative St. Regis dairy farmers, gave us the run of Racquette Point; but cattle had eaten away the flora and, except for a few household remedies, we had to be content with Mohawk paradigms.

The Christianized Mohawks were persuaded to settle at La Prairie in 1668, and here opposite Montreal, Kateri Tekakwitha ("moving-in-two-directions"), Lily of the Mohawks, lived out her saintly life (fig. 100); but the "Praying Indians of Quebec" soon removed to Caughnawaga, now an old stone village of ironworkers, where I located Katie Debeau, who had worked for Waugh in 1912 (fig. 101). With the aid of an illustrated flora and the careful interpreting of Frank Jacobs, we reviewed Waugh's earlier notes; Katie related cases of Mohawk women taking *Cicuta* for the same reasons as the Senecas, and the Mohawk name for the plant is near enough the name given by the Jesuits to clinch its identity.

The balance of the season was spent with Simeon Gibson, J. N. B. Hewitt's old interpreter at Six Nations Reservations near Brantford, Ontario. He also had worked for Waugh, and his sister Jemima (fig. 102) knew the techniques of preparing medicines. We returned to Allegany for the Green Corn Festival at Coldspring longhouse, the season when the herbalists prepare to dig their roots.

All the Iroquois herbalists place tobacco at the first plant encountered and take the second, and individual collectors have particular routes which they habitually traverse when hunting plants. Their range of knowledge is not extraordinary, but a few will know upward of 100 plants; the more common plants like boneset, *Eupatorium perfoliatum* L., and hemlock, which cured Cartier's crew of scurvy in 1535, are known by the same names over wide areas by tribes speaking distinct dialects. Although overdoses occur, the Senecas have learned to bake the poison out of mayapple roots, but water-hemlock they universally fear. Nearly every family has its blood nostrum composed of nearly 20 plants, including bloodroot, sarsaparilla, partridgeberry, pipsissewa, and various barks that are taken by scraping them upward when the prescription calls for an emetic and downward for a cathartic.

SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1940

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PREFACE

In several of the sciences of chief concern to the Smithsonian Institution, namely, geology, biology, and anthropology, field work plays an important part. To collect specimens in little-known regions, to fill gaps in the National Museum collections, and to record data that can be obtained only on the ground, a number of expeditions go out each year from the Institution, some to nearby States, others to remote corners of the earth. A few of these expeditions are financed wholly from Smithsonian funds, but for most of them support comes from private sources or through cooperation with other agencies or individuals.

This pamphlet, which is printed annually by the Institution, serves as a preliminary announcement of the purposes and results of the year's expeditions and field work. Later, after the material has been studied by the specialists at the Institution and its branches, the scientific results are embodied in one of the various Smithsonian series of publications.

The photographs were made for the most part by the field workers themselves.

W. P. True
Chief, Editorial Division.

CONTENTS

INVESTIGATIONS OF ANCIENT CAMBRIAN ROCKS IN THE UNITED STATES

By CHARLES E. RESSER
Curator, Division of Invertebrate Paleontology
U. S. National Museum

With the objective of studying Cambrian strata across the country, we set out from Washington late in June in a light truck equipped with beds and stocked with food, so that we might sleep and eat wherever it suited the exigencies of the work. Charles H. Frey, 3rd, a student at Franklin and Marshall College, served as field assistant.

Our first problem was to relocate two faunas on Copper Ridge, northwest of Knoxville, Tenn., for several questions had arisen concerning their geographic and stratigraphic position. During our brief investigations we were able to find excellent material representing one of these faunas.

For many years I had hoped to become acquainted with the important Cambrian section in the Ozark Mountains. Accordingly, we chose a route through Missouri and spent the better part of a week in looking over the outcrops along the streams and roadsides in the vicinity of Farmington and Van Buren. Here life was made miserable by the superabundance of chiggers, something evidently out of the ordinary because local newspapers were printing many stories of like experiences.

Our next objective was to examine the Cambrian rocks of Colorado. They are mainly quartzitic and therefore have few fossils, which makes their study difficult. A sequence of Cambrian beds occurs in the Front Range near Manitou and in some of the natural parks characteristic of the eastern Colorado Rockies. This thin series of beds was studied near Manitou and in Manitou Park, 70 miles to the north. Another sequence, found in the Mosquito, Sawatch, and other ranges, was viewed briefly west of Tennessee Pass and in Glenwood Springs Canyon but we were unable to attempt the higher altitudes around Aspen because our truck did not have sufficient power to climb the very steep grades.

The next stop was at the Grand Canyon where the Park naturalist, Edwin McKee, by persistent effort has obtained many good fossils and much new information. Arrangements were made for joint publication of the results during the coming year. Outcrops were examined in Meriwitica and Peach Springs Canyons, about 150 miles

Fig. 1.—Green River, showing moraine in the mid-distance which forms the lower lake, Green River Lakes, Wyo.

Fig. 2.—Granite spires on Clear Creek, above Green River Lakes.

Fig. 3.—View across Clark Fork River from Beartooth Mountains. Canyon shows as a line, and is cut in sedimentary rocks. The Absaroka Mountains to the south are composed of lava flows.

Fig. 4.—Beartooth Butte across Beartooth Lake, Wyo. View of Cambrian and Devonian beds resting on the granite.

Fig. 5.—Glenwood Springs canyon, Colorado. Cambrian strata resting on the old crystalline rocks.

west of the Grand Canyon village. Extremely high temperatures and the driest season in 50 years rendered this phase of the work somewhat difficult, but the beauty of the night sky made us forget the heat of the day.

The major objective for the season's work lay in the Wasatch Mountains and the ranges of western Wyoming and southern Montana. For the first time I saw the beautiful Green River Lakes region in western Wyoming. Green River, the major branch of the Colorado, flows out of beautiful glacial lakes, and the branches feeding the lakes flow through lofty mountains in gigantic glacier-cut valleys. Granite spires and cliffs of sedimentary rocks rise 3,000 feet above the lake level. Here we found that both the Middle and Upper Cambrian were represented by only about a thousand feet of strata.

When the Wasatch Mountains were reached, it was gratifying to find that Dr. J. S. Williams, of the Utah Agricultural College at Logan, Utah, had already solved the problems that I had in mind. Accordingly, after a few days in the heat, dust, and smoke it was possible to continue to the Teton and southern Montana ranges. After studies near Logan and in the Beartooth Mountains of Montana, nearly a week was spent studying the Cambrian strata of the Black Hills.

From early July until Labor Day forest fires were burning on every side and interfered somewhat with the work. With the driest season on record, rivers and streams were reduced to about one-fourth their normal volume, and the wind constantly raised great dust clouds. Temperatures were high, even at night.

Since my last visit to the Rockies 10 years ago, great changes have taken place. Old camp sites are gone, their places being taken by picnic grounds and cabins, and where formerly one rarely encountered another person, there are now hundreds. More than 60 miles from the highway one finds paths worn in the grass along the stream banks by hopeful anglers, so that even the trout are now few.

Cambrian rocks are seldom highly fossiliferous. Enormous masses of sediments were deposited in those ancient seas, which we are sure were full of living organisms. For, aside from the evidence furnished by the nature of the sediments themselves, broken fragments of animal remains, scattered everywhere, show that life existed but that conditions were not favorable for its preservation. Occasionally, however, local conditions were such that waves did not break all the shells into fine bits and entombment was rapid enough to prevent decay. There we find beautifully preserved fossils, and it was our good fortune to locate several such spots this summer.

TRAILING EXTINCT ANIMALS IN CENTRAL UTAH AND THE BRIDGER BASIN OF WYOMING

By C. LEWIS GAZIN

Assistant Curator, Division of Vertebrate Paleontology
U. S. National Museum

Continuing investigations carried on during the field seasons of 1937 to 1939, the 1940 Smithsonian Institution expedition in search of fossil vertebrates spent the early part of the summer collecting in the Paleocene and Cretaceous beds of central Utah. The latter and greater part of the season was devoted to middle Eocene beds exposed in the Bridger Basin, southwestern Wyoming.

The party, consisting of George F. Sternberg, Franklin Pearce, and the writer, met in Price, Utah, on June 8. Equipment and supplies were assembled and on the following day camp was made in the Manti National Forest about 50 miles southwest of Price, at the same place from which operations were carried on during the previous summer. The fossil localities in the Manti Forest area visited this season are nearly all in Dragon Canyon, and our efforts were directed almost entirely to reexamination of the Paleocene exposures and in quarrying for additional lizard material in the contiguous Cretaceous beds.

Success was attained in the finding of additional remains of Paleocene mammals, representing a variety of forms. The lizard remains, including several good skeletal portions, were obtained entirely from a small patch of Cretaceous rocks in the lower part of the canyon, and represent at least two distinct types, differing considerably in size.

Having about exhausted for the season the possibilities of further collecting in Dragon Canyon, on July 4 we moved camp to the Bridger Basin in southwestern Wyoming. It was decided to investigate first the badland exposures around Twin Buttes in the eastern part of the basin. It was hoped that camp might be made near a spring, but considerable search and inquiry revealed that the only immediate source of water was located high on the north end of the mountain at a point very difficult to reach with a car. A dry camp was made on the west slope of the northerly butte, and water was hauled from the town of Green River. Fossil materials in general proved to be scattered and somewhat scarce on the west side, except for a concentration of relatively small forms in a white layer about half-

FIG. 6.—Camp on Levitt Creek in the Grizzly Buttes, Bridger Basin, Wyo. Photograph by Franklin Pearce.

FIG. 7.—Investigation of a prospect to the north of Twin Buttes in the Bridger Basin. This small quarry, the general location of which is shown in figure 9, produced a remarkably good carnivore skeleton. Photograph by Franklin Pearce.

Fig. 8.—Searching for jaws and teeth of primitive mammals in the Paleocene deposits exposed in Dragon Canyon, central Utah.

Fig. 9.—Good collecting ground in the Bridger Eocene beds to the north of Twin Buttes in southwestern Wyoming.

Fig. 10.—A general view of camp and the Bridger badlands in the basin of Sage Creek to the north of Lone Tree, Wyo. The Uinta Mountains may be seen in the right background.

way up the mountain. The layer is best exposed in the saddle between the buttes, and while working at this point we were surprised to find an old Indian camp site of considerable extent, as indicated by numerous large circles of rocks. The pattern of the rocks was not conspicuous at close range, but from points higher on the buttes a large number of the teepee circles could be made out.

Further investigation of Twin Buttes showed rather profitable collecting to the northeast, and a second camp was made near the Green River-Manila road. The search was most successful in the lower exposures radiating from the buttes, not far above the underlying Green River formation. A few good skeletons were found and notably a nearly perfect, uncrushed skull of a small, ancient carnivore known as *Thinocyon*.

After nearly a month of working around Twin Buttes, curiosity prompted us to have a try at Bridger exposures on the east side of the basin, so our next camp was made near Grizzly Buttes, at a site occupied by Gilmore's party in 1930. A fair amount of material was discovered, in particular the remains of a primitive titanothere, *Palaeosyops*, and a good number of jaw portions of various small mammals.

Extending operations farther away from Grizzly Buttes, we soon discovered that collecting was particularly good in the extensive badlands not far from Lone Tree, especially near the divide between Henry's Fork and the easterly branch of Sage Creek. As a consequence, toward the middle of August our last camp was made at a place in the upper part of Sage Creek. We were unusually fortunate in finding, practically on the divide, the greater part of a skeleton of the gigantic amblypod known as an uintathere, a mammal with six horns, saberlike tusks, and nearly equaling in size a modern elephant. The only parts of the skeleton of this beast conspicuously absent were the neck, a shoulder blade, the right hind limb, and the lower jaws, although pieces of the latter together with portions of one of the fore limbs were found scattered on the surface. It is anticipated that this individual will prove worthy of being mounted for exhibition in the National Museum.

We were particularly favored this season in having weather that permitted so many working days; however, the last week of August began with a series of heavy rains and cold weather, letting up only toward the end of the week, so that it became possible for us to complete the taking up and removal of specimens upon which work had begun the previous week. On August 30 we moved our equipment and the specimens on hand to the town of Green River, where the accumulated collection was packed and shipped.

GEOLOGIZING IN TEXAS AND TENNESSEE

By G. ARTHUR COOPER
*Assistant Curator, Division of Stratigraphic Paleontology
U. S. National Museum*

It has been the writer's practice for some years to visit sections of the United States from which few fossils are represented in the National Museum collections. Accordingly, a visit to north-central Texas and the Glass Mountains of west Texas was planned. Pennsylvanian fossils abound in the former locality, and the latter is noted for its Permian fossils. In addition to these two areas the itinerary also included west Tennessee, where Silurian fossils may be found. The fact that important localities on the Tennessee River will soon be lost under the ponded waters of the Gilbertsville, Ky., dam made it desirable to obtain collections before these localities are lost. A brief study of the Stones River limestone of central Tennessee was also on the schedule.

In early August the writer left Washington for Fort Worth, Tex., where he joined Mrs. J. H. Renfro and her daughter, enthusiastic collectors and students of Pennsylvanian fossils. With the Renfros as guides to the better localities, the writer collected more than 10,000 specimens of beautifully preserved Pennsylvanian fossils. Most of the collecting was confined to Jack, Young, and Palo Pinto Counties, where the Pennsylvanian rocks consist of thin limestones interbedded in thick sequences of shale and fine-grained sandstone. The rocks lie nearly flat and are well exposed over most of the area. The shales often disintegrate into clay, leaving beautifully preserved fossils lying about on the slopes. Each rain helps to replenish the supply by washing away more clay.

From Fort Worth the writer went west to Marathon, Tex., located 60 miles south-southwest of Fort Stockton. Just north of Marathon, in the Glass Mountains, is exposed one of the finest sections of Permian limestone in the world, aggregating 6,000 to 7,000 feet in thickness and abounding in fossils, particularly in the lower half. Most of these Permian fossils are silicified and can be removed from the rock by dissolving away the limestone with acid. Shells of unbelievable beauty and delicacy can be obtained by this method. Besides the Permian specimens, good Pennsylvanian fossils were collected along the base of the hills about 23 miles northeast of

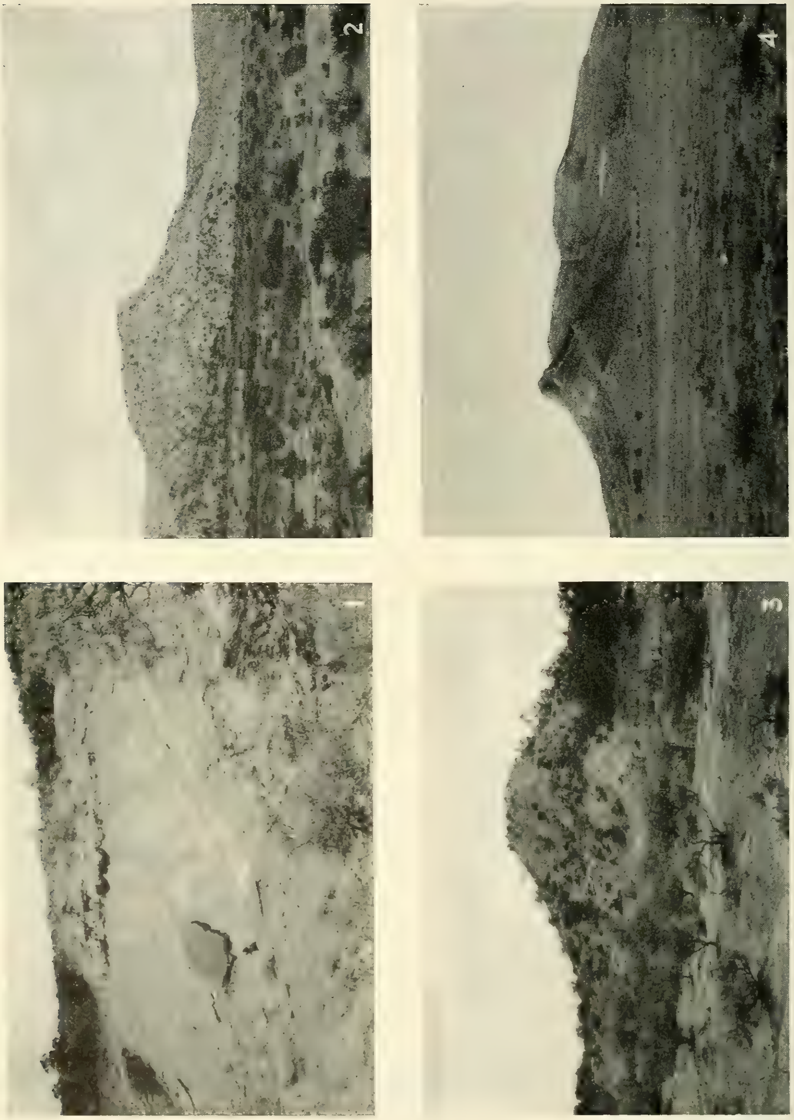

Fig. 11.—1, Light-colored fossiliferous Pennsylvanian shales overlain by thin limestones, northwest of Finis, Tex.; 2, flat-lying Cretaceous rocks resting on Pennsylvanian sediments, 23 miles northeast of Marathon, Tex.; 3, small butte of fossiliferous Pennsylvanian shale, southwest of Berwick, Tex.; 4, tilted Permian limestone in Leonard Mountain, north of Marathon, Tex.

FIG. 12.—1, Blue Mound Glade, about 2 miles west of Brownsport Furnace, Tenn. This glade yielded several thousand brachiopods; 2, view up the Tennessee River near Clifton, Tenn.; 3, fossiliferous Silurian limestone and shale northwest of Bob Landing, Decatur County, Tenn.; 4, Silurian limestone in Lady Finger Bluff, northwest of Perryville, Tenn.

Marathon. Two weeks were spent in the Glass Mountains searching for blocks suitable for etching. Many were obtained, and a fine collection of hitherto rare species is confidently anticipated when the limestone lumps are finally decalcified.

Along the Tennessee River in Decatur, Perry, Wayne, and Hardin Counties Silurian rocks are exposed in bluffs and glades. The same rocks are also exposed in Perry County along the Buffalo River a short distance east of the Tennessee. Although the high river bluffs afford excellent opportunity for the study of the rock sequence, the best collecting is obtained in the glades. These are generally open, bare rock slopes supporting at best only a few cedars, and hence are commonly known as "cedar glades." Occasionally these glades are somewhat conical and are then known as "mound glades." When a new glade, never before collected, is discovered, the geologist is often rewarded by a fine harvest of specimens.

Altogether 3 weeks were spent in west Tennessee collecting Silurian fossils. First the exposures on the west side of the Tennessee River in Decatur County were visited, then working from Linden, the writer visited collecting places in Perry County. The work on the Silurian was brought to a close with a few days of collecting in Hardin and Wayne Counties. Many fine and some rare specimens were obtained in these regions.

At Murfreesboro in central Tennessee, the writer was joined by Dr. Josiah Bridge of the United States Geological Survey. A joint study of the Ordovician (Stones River) limestone was the object of the meeting. These limestones form the lowest exposed part of the Paleozoic column lying inside the "Central Basin of Tennessee" and are surrounded by a rim of Silurian, Devonian, and Mississippian rocks. Bridge and the writer were chiefly interested in collecting the fossils and studying the sequence of layers of four formations—the Murfreesboro, Pierce, Ridley, and Lebanon limestones that make up the Stones River group. A fine collection of Murfreesboro fossils was obtained at the excavation for a new armory on the bank of Stones River just west of town. Good fossils were obtained from the other formations, but the best collection taken came from the Lebanon limestone exposed in a new cut on U. S. Highway 41 about 9 miles southeast of Murfreesboro.

The 2 months' collecting resulted in an abundance of much-needed Pennsylvanian and Permian fossils from Texas and many good specimens of Silurian and Stones River fossils from Tennessee.

COLLECTING LIVE ANIMALS IN LIBERIA

By WILLIAM M. MANN
Director, National Zoological Park
AND
LUCILE Q. MANN

The Firestone Tire and Rubber Company, of Akron, Ohio, financed the Smithsonian-Firestone Expedition to Liberia, its purpose being to collect and bring back live animals for the National Zoological Park, as well as other specimens for the United States National Museum. The party, consisting of the writers and Ralph Norris and Roy Jennier, employees of the National Zoological Park, sailed in February 1940 for Monrovia. We were greeted there by George Seybold, in charge of the Firestone Plantations. He took us to his home at Harbel, some 50 miles from the port, and there we made our headquarters throughout our stay in the Republic.

On such a trip as ours much depends on native assistance. Natives, after all, are the best hunters and trappers. To get acquainted with them, and to get them interested in the work we were doing and the specimens that we wanted to obtain, we spent considerable time in the interior on five different trips, walking from village to village, where we camped. The Secretary of the Interior gave us a letter of introduction to his Government officials, Paramount chiefs and others, explaining what we were there for and asking them to help us.

With the aid of the Firestone Plantations personnel we made a number of drives for antelope. The Company is clearing vast areas of land in order to plant rubber, and there were some isolated forests left. We would surround one of these on one side with a line of rope nets, and then the white managers, leading their troops of employees, would form a ring and drive such animals as still remained in the forest. The natives in a long line would advance shouting, and the frightened animals running ahead of them would sometimes get entangled in the net. In this way we obtained a number of antelopes, among them three kinds of duikers seldom seen in captivity and at present the only representatives of their species in captivity in the United States or elsewhere.

At Belleyella, 5 days' walk into the interior and near the French Guinea frontier, we were shown much courtesy by Lieut. W. S. Wiles and Sgt. Joseph Gibson of the Frontier Force, and W. M. Dennis, of the Revenue Department. Realizing from the Explorers' Club

FIG. 13.—Left to right: The Mullah; Dr. Mann, leader of the expedition; the Paramount Chief (and child); Mrs. Mann, secretary of the expedition; and the Chief's head wife, at Bendaja.

FIG. 14.—Our first pigmy hippopotamus.

FIG. 15.—The end of the road, and the beginning of the first bush trip. Boys and supplies were brought this far by truck; from here on all travel was done on foot.

FIG. 16.—We took a 7-mile short cut over recently felled timber and wished we had stayed on the shady jungle trail.

flag and the Woman Geographers' flag and the senior writer's Masonic ring, that we were "joiners," they arranged for us to join the Snake Society. This Society exists throughout Africa. Each tribe has its own lodge. Our best native companion was Bobo—Bobo Johnson of the Gisi tribe—a devout member of the Society, and he went with us and joined all over again, we think to find out if the ritual were the same as in his own tribe. According to him, it was.

In a dimly lighted hut we were kept at night for 4 hours. After taking the oath of secrecy we were taught high-signs, passwords, the procedure of entering a home, the manner of giving a present to a Snake Society brother or receiving one from him, and the symbolism of a large number of fetiches. Next day, inducted into the sacred bush, we were taught again more signs and landmarks, and the secrets of 36 different species of plants were explained to us. Some were medicinal, some used in sorcery. And then our fellow members of the lodge presented to us the ceremonial snake, a rhinoceros viper which we afterward sent to Washington. Because she was the first white woman who had ever lived in the village, and the second white woman who had ever joined the lodge, the junior author was made an officer, given a title and certain powers. As Yangwah, she has the authority to "cut a palaver," that is, to end an argument, which is a valuable power in West Africa! The native Yangwah surrendered to her the symbol of office, a harnessed antelope horn containing within it the "medicine" of the Society.

Other trips made into the interior in various directions were for the purpose of collecting specimens and getting the natives interested in collecting and bringing to headquarters other animals. This resulted after a time in a constant though rather thin stream of animals being brought in to base camp.

Near Dobli's Island in the St. Paul River a young adult female pigmy hippopotamus was caught by natives in a pit. A cage had to be built for it, using heavy planks for the floor, and stout bamboo for the framework, lashed together with rattan and padded with rice bags. The cage alone weighed 300 pounds, and the hippo weighed 400, making 700 pounds that had to be carried by manpower, up hill and down, over sandy roads and narrow twisting trails, through streams and over fallen tree trunks, for 40 miles—a 2½-days' walk.

The hippo became tame surprisingly quickly. After 2 days in camp she was practically a pet. Later she had to be taken by truck 50 miles down to the coast, loaded into a surf boat, rowed out across the bar and 2 miles out to sea, lifted on board ship by derricks, let down into the hold, kept alive for 21 days on a diet of nothing but

FIG. 17.—Snake Society lodge of instruction. The Gli at left holds a rhinoceros viper; the leaves in the center have medicinal or magic properties.

FIG. 18.—Orchestra and a solo dancer celebrating the return from the Grigri bush.

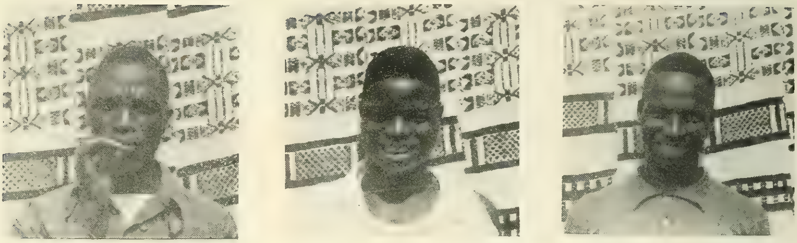

Fig. 19.—Bobo, Flomo, and Pepe, respective heads of caravan, camp, and camera departments.

Fig. 20.—Part of the expedition personnel being ferried across the St. Paul River.

FIG. 21.—Dock at Dakar, Senegal. Barrels of oil and gasoline imported from the United States, and bags of peanuts ready for export.

FIG. 22.—The S. S. *West Kebar,* bound for Monrovia, with wartime decorations.

potatoes when all our greens spoiled, unloaded in Norfolk, and brought to Washington by railway express. In spite of all she went through to reach the Zoo, she is still thriving.

One camp in the interior was much like another, even though each tribe is very different. We were usually given the official rest house in which to camp. Water was boiled and filtered. Sometimes tins were opened, at other times we ate the classic dish of West Africa, palm oil chop. To make this the cook takes a cluster of palm nuts, scalds them, crushes them, and pours hot water over them. Two products result, one a rich palm oil, one a palm butter about the consistency of applesauce. Chicken, or preferably game, is cooked in palm oil. Hot native peppers are cooked in the palm butter, and both are served, with the chicken, poured over rice. Our supplies were carried on the heads of native porters, usually 40 to 50 pounds for a load, and the caravan traveled about 20 miles a day. One gets the impression that Liberia is teeming with animal life, smaller in size but perhaps as abundant as that on the great plains of East Africa, but seldom seen because of the dense forests which cover practically all the territory of the Republic.

Our last trip into the interior was to an abandoned plantation near Reputa. This had been established by Polish citizens and had been planted largely in cocoa. They abandoned it early in the war, and it remained much as they left it. The neat little house contained strips of flypaper still dangling from the ceiling, and portraits of Paderewski and Pilsudski hanging on the wall. We were accompanied on this trip by Mr. and Mrs. Louis Chancellor of the Plantation, and devoted most of our time to collecting specimens of fishes in the small streams nearby.

Some of our live specimens were sent back in May in the care of Mr. Jennier, spent the summer at the Firestone Exhibit at the New York World's Fair, and afterward came to the Zoo. The others were brought back by Mr. Norris and ourselves on the *West Irmo,* arriving in Norfolk August 7, and afterward were placed on exhibition in Washington. Practically everything obtained was new to the National collection.

Besides the antelopes already mentioned, pigmy hippopotami, chimpanzees, pottos, a West African ratel, monkeys, civet cats, hornbills, monkey-eating eagles, cobras, vipers, and pythons were collected. In addition to the live animals and birds, some 3,000 preserved fish, reptiles, and batrachians, quantities of insects not yet assorted, a number of dried animal skins, and a few ethnological specimens were brought back for the National Museum.

AN ORNITHOLOGIST IN GUANACASTE, COSTA RICA

By ALEXANDER WETMORE

Assistant Secretary, Smithsonian Institution

With the first rays of the sun on the morning of Columbus Day, 1940, I was awakened by a soft flow of Spanish to see from my stateroom window the bay and shore of Puerto Limón, Costa Rica. One of the most interesting countries of Central America was now before me. Officials charged with landing formalities received me courteously as the guest of their government and presently, in company with Dr. Juvenal Valerio Rodríguez, Director of the Museo Nacional, who had come to meet me, I was on the train traveling up the beautiful valley of the Río Reventazón. San José, the capital city, located near the western edge of the central plateau, holds many attractions so that a week here passed rapidly and pleasantly, occupied fully with meeting scientist-colleagues, with visits to officials of the government, and with examination of the important collections in the Museo Nacional. There was time also for an excursion to an interesting fossil deposit at San Ramón.

Early on the morning of October 19, in company with Dr. Valerio and Carlos Aguilar (the latter in charge of the zoological collections in the museum), I was on the Taca plane en route for the region in northwestern Costa Rica where my work with birds in the field was to begin. From the airplane I saw most of the Nicoya Peninsula in passing as we landed at several towns—Nicoya, Santa Cruz, and Paso Tempisque—before coming down finally at Liberia, capital town of the Province of Guanacaste, where my headquarters were to be.

Guanacaste is a land completely apart from the elevated, thickly populated tableland of central Costa Rica. Roads are primitive so that travel for a good part of the year is by oxcart and horse. Only during the dry season are the rough trails passable for trucks, and then only through skillful driving. The land is divided in great haciendas with cattle raising as the principal industry, and settlement is restricted to scattered, small towns. Along the valley of the Río Tempisque and in limited sections elsewhere there are small farms of corn, beans, and rice, but over vast sections there is only scrub forest and pasture land traversed by cattle trails where houses have been built only at wide intervals.

To this region the airplane service from San José is truly a godsend. As our trimotored plane dropped down into the little landing

FIG. 23.—The Finca Piedades, near San Ramón.

FIG. 24.—A Taca plane at Nicoya.

Fig. 25.—A street in Liberia, Costa Rica.

Fig. 26.—The oxcart is an ordinary means of transportation in Guanacaste Province.

fields, sometimes swooping first in a low circle to drive away a band of horses, passengers got on and off and much freight was loaded and unloaded. The mail sack, boxes, bundles, and sacks of every description, a crated pig, a little dog in another box, my own field outfit—all these appeared at the different airports.

In Liberia, called the "White City" because of its streets of white sand, Dr. Valerio left us, and immediately I took up my investigation of the birds of this region. The land here was fairly level, cut by the Río Liberia, a small, shallow stream of clear water, with rapid current, and by sandy-bottomed quebradas that drain into this stream. The end of the season of rains was near and many days were continuously clear. Storms came mainly in the afternoon and at night. The air was cool and delightful as the sun rose in early morning but by 10 or 11 o'clock the tropical heat drove birds to cover, so that Aguilar and I found it best to return then to town.

Parrots and parrakeets were here in abundance, crossing the sky morning and evening in pairs or flocks, with strident screeching and chattering. During the day I found them feeding in wild fruit trees, sometimes in company with large-billed toucans. The woods and old fields bordering the river were a fertile collecting ground, and here I obtained a steadily mounting number of species of birds. The white-headed laughing falcon called here in early morning, while the petulant screams of smaller hawks came from nearer at hand. Handsome racquet-tailed motmots sat near the cut-banks along the stream, and eight or nine species of hummingbirds ranged in the heavy shade, or about flowers in the open, according to their needs. Howler monkeys roared their disapproval of my shooting, and almost daily we saw deer within a mile of town.

Through the more open areas were the great spreading trees called Guanacastes, of the mimosa family (*Pithecolobium saman*), often 8 or 10 feet through, that grew with especial symmetry in the open pastures. In these I found small woodpeckers, tanagers, the kiskadee flycatcher, and its large-billed cousin, the boat-billed flycatcher. The tiny beardless flycatcher (*Camptostoma*) no larger than a kinglet also ranged in the delicate foliage, with bright-colored euphonias, chattering woodpeckers (*Centurus*), and occasional migrant warblers from the north.

Barn swallows circled over the open fields often in considerable flocks, and at sunset flocks of Baltimore orioles and scissor-tailed flycatchers came into town to roost in groves of trees behind the houses. These were all migrant friends from the United States.

Trips by truck to the Río Colorado 5 miles to the northwest were always fruitful, as tanagers, cuckoos, sparrows, and other strange

FIG. 27.—A great Guanacaste tree by the roadside, a species that has given its name to the Province.

FIG. 28.—Leaving the Hacienda Santa María for the lowlands.

birds were there in variety. One of the most interesting species of the region was a brown cuckoo (*Morococcyx erthropygus*) that fed on the ground in high grass and weeds, coming up into view only when startled. The blue and orange color of the bare skin about the eye was striking.

On clear days mountains to the east of us were constantly in view, and with field glasses I could see the forests that covered their slopes. By invitation of Bert De Langton we rode nearly 5 hours to the Hacienda Santa María, on the southern slopes of the Volcán Rincón de la Vieja, a ranch comprising approximately 22,000 acres of land. Carrying our outfit on pack animals we crossed a sandy, arid stretch where the oak trees were scattered, small, and stunted, to come to the foothill region where the soil was rich and the tree growth heavy. Above a small coffee grove behind the hacienda house there began a great rain forest that extended practically uninhabited over the mountain toward the distant frontier of Nicaragua. In the dense forest I traveled with gun in one hand and machete in the other to cut a passage, and open slopes were often waist high in grass. Only a few trails were clear for horses.

Our meat was game—the flesh of deer and peccary, and of the great guans (*Penelope purpurascens*), birds as large as small turkeys that ranged in bands in the tall forest trees. Daily I saw fresh signs of jaguar and tapir, and howler and white-faced monkeys were more abundant than I had ever seen them before.

Among the birds the most striking were the great red-blue-and-yellow macaws that were found in flocks constantly about the house. In the forest I collected specimens of a great variety of strange and unusual species. To observe them at their best it was only necessary to locate moving ant armies, as about these the forest birds congregated in abundance. Curious ant-birds chattered and called, stiff-tailed woodhewers climbed up the tree trunks like woodpeckers, and tanagers, vireos, and occasional migrant warblers passed along the branches overhead. Sometimes birds that I shot fell among the ants and were retrieved only at the expense of burning bites and stings.

Mist and rain kept the undergrowth perpetually wet so that it was seldom that I returned dry from a morning afield.

This interesting field work had finally to come to an end, so that one morning found me seated again in the plane with collections and equipment loaded in the baggage compartments in the great, extended wings. In less than 3 hours I was once more in the cool uplands of San José, and 4 days later, on November 23, I bade goodbye to Dr. Valerio and to Aguilar on the pier at Puerto Limón, with regret that time did not permit further work in this fascinating region.

COLLECTING BIRDS AND MAMMALS IN SOUTH CAROLINA

By W. M. PERRYGO
Scientific Aid, Department of Biology
U. S. National Museum

Last year (1939) our intensive work in the collection of birds and mammals for the National Museum was carried on in North Carolina. In 1940 it was arranged to follow up that work with investigations in South Carolina, making a special study of the southern end of the Appalachian Range and the southern forms along the coastal plain. Through the courtesy of A. A. Richardson, Commissioner of Game and Fishes, Columbia, S. C., officials of the National Forests, and land owners we were able to make the necessary arrangements.

Leaving Washington April 8, with J. S. Y. Hoyt as assistant, we began work near Conway, in Horry County, collecting in the flat pine woods, in cypress swamps, and in the salt marshes near the coast. Our 10-day stay here netted many interesting and desirable specimens. Then moving southwestward farther toward the interior of the coastal plain we settled in Dorchester County near St. George, working along the drainage of the Edisto River. Most of our collecting was done in the cypress swamps, in open pine woods, and near the edges of cotton fields.

Next we moved to Hardeeville to investigate the Lower Austroriparian life zone as it occurs in the extreme southern portion of the State. Most of our work was done in Beaufort County in the cypress and deciduous swamps, and through abandoned farms, salt marshes, and islands—the latter including Hilton Head. Painted buntings and chuck-wills-widows were very common, and bird life in general was much more abundant than in previous areas.

We then moved northwestward into the Piedmont region in the vicinity of Union, working Union and Newberry Counties in Sumter National Forest. In old broom-sedge fields we found Bachman's sparrows, and along the streams were the usual types of birds occurring in such localities. Journeying southwestward along the Savannah River, we settled at McCormick, where again the Sumter National Forest offered us ample collecting grounds over the pine-covered rolling hills in McCormick, Edgefield, and Abbeville Counties. One of the most interesting finds here was the nesting of the mountain vireos which we had known elsewhere only in more elevated regions in the mountains. While here J. C. Calhoun joined us to assist primarily in mammal collecting.

FIG. 29.—A typical coastal plain region of open pine woods where brown-headed nuthatches and red-cockaded woodpeckers are found, near Allendale, S. C.

FIG. 30.—W. M. Perrygo and R. B. Vance in a cypress swamp near Allendale, S. C.

FIG. 31.—White sand and scrub oak—a typical association in South Carolina.

FIG. 32.—Fall plowing near Olanta, S. C.

Moving northwestward to Walhalla, we collected along the Chattooga Ridge in Oconee County. Here we found golden-winged and worm-eating warblers and mountain vireos in abundance.

The final area for the summer was in the vicinity of Caesar's Head in Greenville County, where we collected along Standing Stone, Caesar's Head, Bradford, and Sassafras Mountains—the latter being about 3,500 feet in elevation, and the entire area the most elevated in the State. The slopes are steep and deciduously wooded and housed more of the mountain forms than the previous section despite the absence of typical Canadian flora. A few pairs of song sparrows were nesting here, in addition to chestnut-sided warblers. This completed the spring and summer investigation for the season, and we returned to Washington July 23.

Accompanied by John Webb, of the Division of Birds, I left for the fall collecting trip September 14. Our first stop was at Rock Hill above the fall line in northern South Carolina. Most of our work was along the rolling hills bordering the Catawba River and in the wooded bottom lands so typical of the Piedmont region. In spite of the unusually warm weather we found representatives of the birds that we needed to tie in with those collected in North Carolina just to the north along the same river during the previous year. On October 2 we moved eastward to Cheraw to work along the Pee Dee River. The swamps along the river yielded valuable specimens.

On October 16 we continued southward to Allendale to complete the work along the Savannah River. Through the courtesy of R. B. Vance, of Allendale, who gave us permission to collect on his farm, we found an excellent concentration of bird life in the cypress swamps and open pine woods, and along the edges of the fields—all within a short radius, which is most unusual for the coastal plain. Brown-headed nuthatches, red-cockaded woodpeckers, Bachman sparrows, and other birds typical of these habitats were rather numerous.

The next 2 weeks were spent in Olanta working along the Lynches River, one of the slow-moving tributaries of the Pee Dee River. The final area centered around McClellanville, in Charleston County, where we had an excellent stay, collecting in the salt marshes near Cape Romain Wildlife Sanctuary. Sharp-tailed and seaside sparrows, rails, and boat-tailed grackles were seen in great numbers. In the interior we worked in the Francis Marion National Forest. The red-cockaded woodpecker was more abundant here than in any area investigated. Equally abundant were wild turkeys which are said to be descendants of the original wild strain native to this area. December 1 brought the survey to a close.

COLLECTING HABITAT GROUP MATERIAL IN THE CANADIAN ROCKIES

By W. L. BROWN
Chief Taxidermist, U. S. National Museum

In October 1940 the first habitat groups with painted backgrounds—moose and caribou—were completed in the United States National Museum. While they were being constructed, two other such groups were being planned, namely, a Rocky Mountain goat and a Rocky Mountain sheep group. In order to select settings and obtain material for these, it was necessary to visit British Columbia and Alberta in Canada, regions from which the mammals to be used were collected some years ago by Dr. Charles D. Walcott.

On July 11 I left for Field, British Columbia. Field, a most picturesque spot located in the Kicking Horse River valley, is surrounded by Mount Burgess, Mount Field, Mount Stephens, and Mount Dennis, all four of which are over 8,000 feet in altitude. I was told by several people living at the Y.M.C.A., where I made my headquarters, that at certain times of the year goats could be seen on the ledges of Mount Burgess, just opposite the Y. Mr. Holman, Acting Superintendent of Yoho National Park, offered me his full cooperation in making the trip a success.

My first field trip was to Yoho Valley chalet camp to obtain data on the formations there. This valley is said by many to be one of the most beautiful of the entire Rockies. The camp is situated in a meadow within sight and sound of the Takakkaw Falls.

Arrangements were made for a trip up Mount Burgess from the Emerald Lake side. A guide was employed, and horses were obtained to bring back the material to be collected. At a point 7,020 feet up as indicated by the altimeter, we reached an angular shale cliff which I decided would make an especially fine setting for the goat group, having seen four goats, many tracks, and much goat hair lodged in larch trees here. Rock rabbits running in and out of the ledges of shale and the whistling of the marmots added to the interest of this spot. The President Range, rising high into the clouds, made a perfect background picture.

Wildflowers bloomed profusely here, and it was interesting to note how the flora changed as we ascended the mountain. Photographs were taken, measurements of the rock formation were made, and a complete collection of the flora was obtained, along with soil and shale. Among some of the plants collected were the heather,

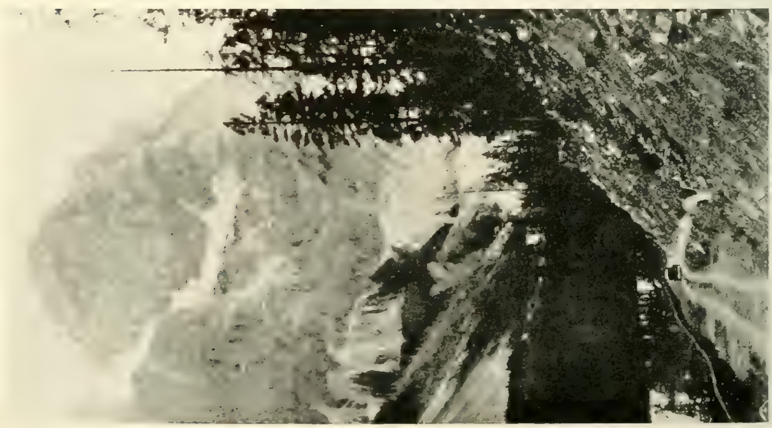

FIG. 33.—Mount Stephens, British Columbia.

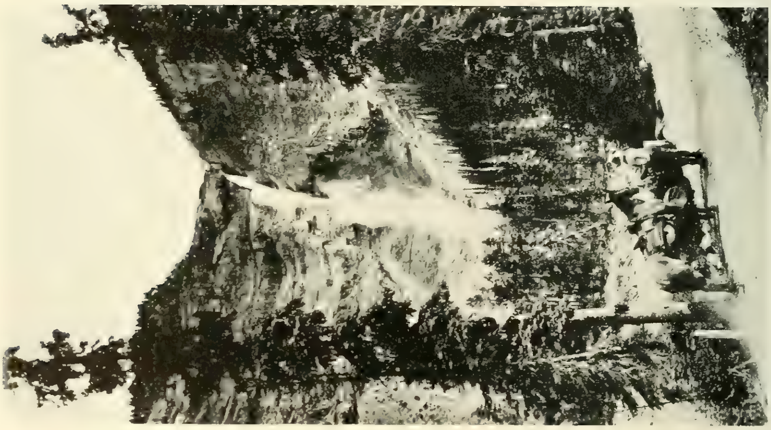

FIG. 34.—Takakkaw Falls, Yoho National Park.

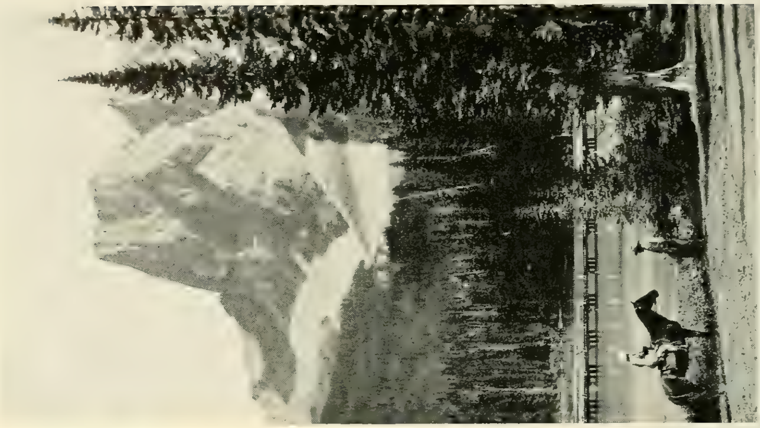

FIG. 35.—Mount Burgess, Yoho National Park.

FIG. 36.—President Range. Background scene for goat group.

FIG. 37.—Scene selected for the sheep group.

windflower, mountain sorrel, Indian paintbrush, moss plant, flowering wintergreen, and sedge. Several alpine larch trees and juniper bushes were also taken to complete the natural setting for the group. The abundance of fireweed and Indian paintbrush added much color to the hills.

With all the necessary specimens for the goat group packed and shipped, I turned my thoughts to the sheep group. Banff had been suggested as the proper locality for the sheep work, and on July 22 I left Field for that place. Located in the heart of the Rockies, surrounded with snow-topped mountains covered with evergreen forest, Banff is indeed a spot of exquisite beauty. Major Jennings, Superintendent of the National Park, advised me to make my collections at the Gap, 23 miles east of Banff on the road to Calgary. He informed me that on one occasion he had seen 50 sheep at that very spot. Most generously he allowed Mr. Ashley, one of his wardens, to take me to Mount Grotto at the Gap. We had not been there more than 5 minutes before I caught sight of my first sheep. After a little exploring, I too was convinced that this place would make a perfect setting for our sheep group. The mountains in the background, being without glaciers, would form a decided contrast with the mountain backgrounds of some of our other habitat groups. These mountains were Mount Pigeon (7,855 feet), Mount Lougheed (10,190 feet), and the Three Sisters (8,850 feet).

On the way back to Banff it was my great pleasure to see 30 elk in a herd and a coyote, two mammals I had never before seen in the wild state. I also saw black bear, mule deer, ground squirrels, and gophers. Arrangements were made with a man owning a truck to take me back to Mount Grotto and to help collect material for the group.

Among the plants obtained from this mountain were snowberry, bearberry, wild rose, buffaloberry, serviceberry, yarrow, chickweed, catchfly, bellflower, and the nodding onion. Wild currant and wild raspberry bushes also grew in abundance here. Photographs were made of this section, and color notes were taken in order to assist the artist in reproducing a natural and effective background.

While at Banff, I visited the National Museum, seeing a fine representative collection of mounted birds and mammals of that region, along with well-arranged exhibits of the flora and geologic collections.

On July 30 I left for home, greatly pleased with the results obtained. Much credit for the success of the trip is due to the splendid cooperation of the Superintendents of the Yoho and Banff National Parks, together with that of the guides and employees of the Canadian Pacific Railroad.

COLLECTING MEXICAN REPTILES AND AMPHIBIANS

By Dr. and Mrs. HOBART M. SMITH

Having been awarded the Walter Rathbone Bacon Scholarship in 1938 for the purpose of continuing studies on the reptiles and amphibians of Mexico, we spent the first year collecting in parts of Mexico that could be reached by car. With our truck we camped through the state of Chihuahua from Cuidad Juarez to Torreon, Coahuila. Here the road became a highway, and during the remainder of the year we followed the highways of Mexico which took us through Mexico City south to Acapulco, west to Guadalajara, east to Potrero Viejo in the state of Veracruz, and north to Laredo, Texas. Various side trips were made when road conditions permitted.

In May 1939 we left our truck at the home of Dyfrig Forbes in Potrero Viejo, Veracruz, and by train, freighter, riverboat, and mule reached Piedras Negras, Guatemala, located on the Usumacinta River near Tenosique, Tabasco. After a very profitable month, during which we were guests of Linton Satterthwaite, Jr., who was studying the ruins at Piedras Negras, we returned to Emiliano Zapata, Tabasco.

From Emiliano Zapata we went by horse to Palenque, Chiapas. Palenque is a tiny village consisting of palm-thatch houses with absolutely no accommodations for travelers. San Juanito, the ranch of Don Ernesto Rateike, about 1 kilometer from Palenque, is very comfortable, and here we remained almost a month. Collecting here was fair. It should be wonderful in the rainy season; we were there during the rainy season, but it failed to rain.

At the end of July we made our way by boat to Veracruz, picked up our car in Potrero Viejo, and during the month of August and the early part of September made various collecting trips on the highways accompanied by Dr. E. H. Taylor. Our previous stops in these localities had been made during the dry season. Various faunal changes are apparent through the seasons. For example at Agua del Obispo in Guerrero, a species of lizard (*Uta bicarinata*) with a blue spot under its chin was collected during the dry season. During the rainy season none were found, but *Anolis megapholidotus,* which has a bright red dewlap, were plentiful. They had not been found in the dry season. The natives insisted, "It is the same lizard; it just changes the color of the spot in the time of the rains."

After these trips by car we returned to Potrero Viejo. The highway between Mexico City and Potrero exemplifies the great variety of types of country covered in a few hours on any of the Mexican

FIG. 38.—My wife is thinking this Ctenosaur would be better for the frying pan than for the alcohol can.

FIG. 39.—Seining pools at 9,000 feet for axolotl salamanders is chilly work even in summer. Smith managing to keep up with Dr. Taylor for a while.

FIG. 40.—Lizard collecting in this ravine near Tehuantepec makes good gymnastics.

FIG. 41.—The north woods in Mexico. El Chico Park, near Pachuca, Hidalgo.

highways. Starting from Mexico City, we leave almost immediately the desert plateau and climb into crisp, sweet-smelling pine forests near the snow-capped volcanoes. A little over an hour brings us to another desert region, which becomes increasingly drier as we approach Tehuacán. A half hour from Tehuacán the highway makes a sudden drop of 2,000 feet. Warm air rising from the valley condenses at these mountain tops and every afternoon a heavy fog covers the hills for a very short distance. Here we very suddenly leave desert hills and find before leaving the mountains a few green hills, grassy and scattered with trees which are filled with many bromelias. After the steep drop in the highway the countryside gradually becomes more verdant for about 20 miles to the town of Orizaba. Again a drop in altitude, this time gradual, takes us into a region of dense tropical vegetation. Here are sugar plantations, bananas, and coffee. Below Potrero the coastal plain is reached, which at Veracruz is dry grassland with scattered low trees and, along rivers, very heavy brush.

We arrived on New Year's Eve by train in Tehuantepec, Oaxaca. We had hardly established ourselves there in the boarding house of Doña Carmen when we were serenaded by a group of little boys singing a plaintive little tune, "Charity, charity for this poor old one—" The old year, a dummy made of old clothing and straw, happily smiling a silly painted grin under an old sombrero, was enthroned upon an old chair which they carried. Later they spent the alms received for sodas. The next day we found the old year in a back yard, his smile a little hollow, for the pigs had eaten one of his arms.

An interesting side trip from Tehuantepec was to Salina Cruz. Here we hoped especially to collect a sea snake. The people there knew them well, "Yes," they would say, "black above and yellow below. Now just the other day a fisherman came in with one. . . . ." Whatever joy we might have had in our specimens from Salina Cruz was dulled by the fact that among them was no sea snake. Later one of the boys brought one in. At the present time it doesn't matter so much that we did not collect it ourselves, but at that time it did.

After Tehuantepec, two of the most profitable months of the trip were spent in southern Chiapas at La Esperanza, the home of E. Matuda. During July and August, through the assistance of Dr. Alfonse Dampf, the Dugès collection from the Alfredo Dugès Museum of the state college in Guanajuato was brought to the Polytechnic Institute in Mexico City, where it was possible to study the collection.

Our field work ended in August 1940, and we found that our collections totaled a little over 20,000 reptiles and amphibians belonging to about 500 species, many of them new to science.

ALASKA KING CRAB INVESTIGATIONS, 1940

By WALDO L. SCHMITT

Curator, Division of Marine Invertebrates, U. S. National Museum

Many of us have relished the "fancy deep-sea crab meat" packed by the Japanese, but few of us are aware that much of it is said to come from water adjacent to our own Alaskan Bering Sea coast. The crustacean from which this delectable crab meat is derived is the king crab (*Paralithodes camtschaticus*). It represents a potentially valuable resource of the sea as yet unexploited by American fishing interests. For this reason the United States Fish and Wildlife Service sent out an expedition to Alaska to investigate the biology of the king crab and its commercial fishing prospects.

A small floating cannery, the M. S. *Tondeleyo,* and a trawl boat, the *Dorothy,* were chartered and provided with necessary equipment, crew, and scientific staff, including Joseph Puncochar, technologist and canning expert in charge of canning methods and allied experimental work; Roy Christey, economist, to study costs of operations in all their phases; Carl Carlson, fishery expert, in charge of commercial gear and studies regarding the relative efficiency of the various types of gear employed in catching crabs; C. J. Pertuit, graduate student of the University of Washington, assistant biologist; and the writer, representing the United States National Museum, biologist and leader of the field party; master of the *Dorothy,* Capt. Ellsworth F. Trafton; and master of the *Tondeleyo,* Capt. A. V. Nelsen, who also acted as superintendent of cannery and commercial fishing operations.

The area designated for investigation this year lay south of the Alaska Peninsula and extended from Ikatan Bay on the west to Shelikof Strait between Kodiak Island and the mainland in the east, from the shallower waters inshore out to the effective range of the gear with which we were furnished—about 90 fathoms of water.

We left Seattle on August 28, and the cruise up the Inside Passage was warm and sunny. Several brief stops formed enjoyable breaks in the trip.

At Ketchikan we consulted with the Assistant Director of the Fish and Wildlife Service, Charles E. Jackson, and R. W. Harrison of the Service's technological laboratory in Seattle, who has direct charge of the king crab investigation in its entirety. Petersburg, which I

Fig. 42.—Rain clouds drifting across the wooded valley in which is located Ketchikan, the busy metropolis of southeastern Alaska. There is no lack of rain here; rather, there is a dearth of sunshine. Nevertheless, it is a picturesque place.

Fig. 43.—Two of our good friends at Petersburg, Alaska: Earl Ohmer, best known as the shrimp king, to the right, and, beside him, Fred Porter, who in years past has given the National Museum a number of interesting specimens.

FIG. 44.—Looking toward Pavlof Volcano from Tolstoi Point as we enter the bay named for the volcano. The volcano is an active one, and every little while it emits a sizable puff of smoke. The companion peak to the right is inactive. We called the pair "old Pavlof and his wife."

FIG. 45.—A boatload of king crabs taken with a tangle net. The fisherman is holding up a large male about 8 inches in width of carapace or shell.

had long wanted to visit because of my interest in shrimps and crabs and all that pertains to them, claims to produce more shrimps than any port in the world. Here I made the acquaintance of Earl Ohmer, shrimp king of Alaska, and his packing plant foreman, Fred Porter. Ohmer befriended the Hancocks, with whom I have made several trips to the Galápagos Islands, when they were shipwrecked in Wrangell Narrows in 1928. Fred Porter was an old friend of the Museum who 5 years earlier, in 1923, had presented the Institution with a large treelike alcyonarian or fleshy coral, the largest in the National Museum's collections, where it is now on exhibit.

Off Perryville, the village established by our Government for the survivors of the destructive eruptions of Mount Katmai in 1912—Katmai of the "Valley of 10,000 Smokes"—we anchored in order to make a few needed repairs to our main engine. With a sizable party of natives, Leslie Melvin, the local Indian-school teacher, put out through the surf to welcome us ashore. On the way in the native boatmen apparently were so much interested in us strangers, or in what we had to say, that they paid no heed to the surf. Just as we were about to land we were overtaken by a huge breaker. Boots were filled with water and we were thoroughly soaked waist high. Too late to escape, we saw the comber breaking over the stern and rose to our feet to meet the rush of water. This alone saved our cameras; otherwise our pictorial record of the cruise would have ended at Perryville before the first crab had been caught. I asked Leslie later, "Was that an accident, or did the natives want to see if we newcomers on the Alaskan scene could take it?" He hastened to assure me that it was not intentional; but those natives certainly had the laugh of their lives.

The evening of September 12 saw us safely anchored at our headquarters for the next 5 weeks—Canoe Bay, off the northwest corner at Pavlof Bay. Our first task was the installation of the "waterworks." In a suitable steep stream, preferably under a small waterfall, a barrel was installed high enough on the mountainside to provide sufficient pressure to carry the water through a series of pipes or a hose. This pipe line was carried out some little distance into the water, where it was secured to a line and marker buoy so that the end of the hose might be lifted into the large lifeboat which was used to ferry the fresh water back to the ship.

The *Dorothy,* on her arrival some days after the *Tondeleyo,* went actively to work with her omniverous otter trawl. This had an effective fishing opening approximately 85 feet wide by some 10 or 12 feet high. As many as 500 king crabs were caught in a single day

FIG. 46.—A hundred or more Canoe Bay king crabs, taken with the *Dorothy's* otter trawl. The bucket in the background gives one some idea of the size of these large crustaceans.

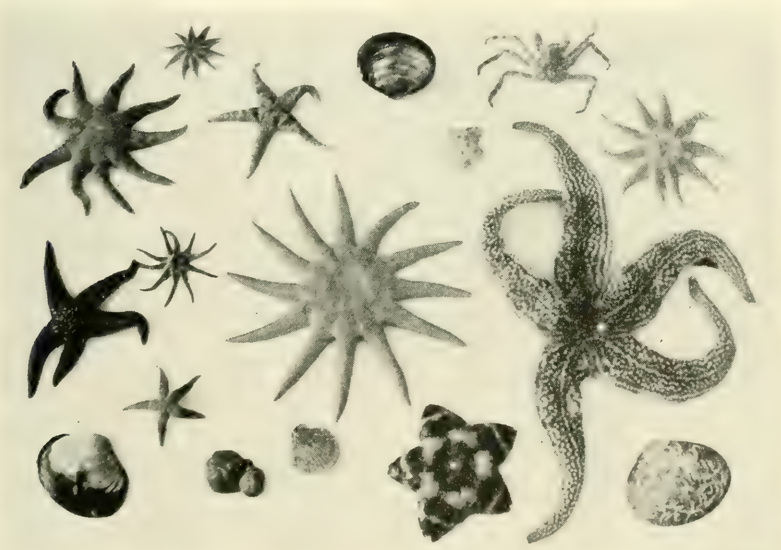

FIG. 47.—A few of the shells and starfish taken with otter trawl in Canoe Bay. Most of them are brilliant red sun stars. At upper right is a baby king crab about 2 inches in width of body.

in Canoe Bay, but not every day was so successful. In the course of the season's operations we caught several thousand crabs.

From Canoe Bay we moved over to Dolgoi Harbor, in the Pavlof Island group, and a week later over to Mist Harbor, Nagai Island in the Shumagins, for a similar length of time. From these bases fishing trials were made in all directions out to sea, among the islands, and up into all promising bays on various types of bottom and in varying depths, but no king crabs were discovered in these areas at this time of the year except for a few isolated individuals in Cold Bay and adjacent Lenard Harbor. Therefore on November 28 operations were transferred to Alitak, west end of Kodiak, where several hundred cases of king crabs had been canned by an earlier though unsuccessful venture during the first half of 1933. Except for Olga Bay, which is tributary to Alitak Bay, our luck was no better than that encountered elsewhere since leaving Canoe Bay. In Olga Bay we not only got several hundred king crabs of the familiar reddish species (*P. camtschaticus*) taken so far, but also between three and four dozen deep blue ones representing a second species of *Paralithodes, P. platypus.* The meat of the latter when canned is indistinguishable from that of the former, in either appearance or taste.

So that we might discover something regarding the movements of the crabs, or at least the date of the arrival of a considerable body of them here at Alitak, while the expedition as a whole worked farther to the eastward, Pat Pertuit, and Jim Scrivner of the *Tondeleyo's* crew were left behind. Quarters were made available at Alitak and at Olga Bay by the Pacific American Fisheries and the Alaska Packers Association, respectively.

Our last fishing trials of the current season, which was to terminate on December 1, were made over on the north side of Shelikof Strait, east of Kukak Bay, our last base, between November 15 and 20. They returned about 70 crabs, including in the very last haul the largest and heaviest crab taken, a 16-pounder, just about 10 inches in width of shell, or carapace, and approximately 56 inches wide over the laterally extended legs.

The wealth of bottom life picked up by a commercial otter trawl is a revelation to those who have never seen one in operation. On more than one occasion, Canoe Bay, Pavlof Bay, and elsewhere, we picked up close to a ton or more of marketable sole and flounder; at other times, in Olga Bay, all of a thousand pounds or more of good-sized shrimp, chiefly species of *Pandalus.* Now and then we would get a solid haul of purple starfish, and once in Shelikof Strait over 300 7-inch ocean scallops (*Pecten caurinus*), which furnished us a memor-

FIG. 48.—A windy day in lower Pavlof Bay; spray blowing over the deck, almost obscuring the *Dorothy's* pilot house.

FIG. 49.—Taking the temperature and sampling the water at Stepovak Bay. This snow-rimmed body of water was not as cold as one might think. At 7 o'clock in the morning, October 25, the surface registered 5°.41 C. (41°.74 F.). Near the bottom, 22 fathoms down, the water was warmer, 9°.90 C. (49°.64 F.).

able sea-food treat. The host of marine animals of all kinds that came to hand is almost indescribable. It was not long before we were pressed for suitable containers and preservatives, so many were the kinds of fish and shells and other invertebrates that were of interest to the Museum. The king crabs were difficult to preserve because of their large size and spidery habitus.

On the whole we had remarkably good weather the greater part of our 3 months in the field, with very little freezing weather. One night in Olga Bay it went down to 29° F.; in Kukak Bay, toward the middle of November, the thermometer registered 26° F. at 7 in the morning. We had a windy session both times that we passed the Barren Islands, on our way into Alitak on the *Dorothy* on October 30, and again on one of our crossings of Shelikof Strait; but the blow I shall remember longest was a fierce sou'easter we rode out at anchor aboard the *Dorothy* in Lenard Harbor on October 11.

That afternoon the increasing force of the wind warned us that we had better give up our fishing trials in Cold Bay and make for the nearest shelter, Lenard Harbor. The gale must have reached its peak about 5 p.m., for the *Dorothy* started dragging her anchors. Both were out with all the chain and cable we had for them. Had not the wind fallen off more rapidly in the next 30 minutes than it made up during the several hours preceding, we might not have been here to tell the tale.

Homeward bound from Kukak Bay we lost little time. Two days after the *Dorothy,* the *Tondeleyo* tied up at the Fish and Wildlife Service dock in Seattle at 4 p.m., December 11, officially marking the end of the 1940 field work of the Alaska king crab investigation.

GREENLAND EXPEDITION OF 1940

By Capt. ROBERT A. BARTLETT
New York City

Last spring, because of the international situation, the prospects of my making a trip north again in 1940 aboard the *Morrissey* seemed very dark. After due formalities, however, I received permission from our own State Department to enter Newfoundland and Labrador ports, and from the Danish authorities to land in Greenland. Accordingly, I went ahead with preparations to put the *Morrissey* in commission.

Again Dr. Waldo L. Schmitt, Curator of Marine Invertebrates, United States National Museum, supplied us with collecting equipment. David C. Nutt, who made his fourth trip north with me this year, helped me most efficiently to get everything in readiness for the trip. Capt. J. F. Hellweg, U.S.N., Superintendent of the U. S. Naval Observatory, and also Capt. G. S. Bryan, U.S.N., Hydrographer, supplied us with instruments, books, and charts. In return, we sent the Hydrographic Office detailed observations of ice conditions, berg movements, and surface-water temperatures taken every 3 hours, anchored or steaming, in ice or out of it. Also, meteorological data were sent to the Navy Department by our own radio. Hundreds of bottle papers were thrown overboard. This we have done both in the eastern and western Arctic. We get a thrill when the papers are returned after having gone 2,000 to 3,000 miles, and having been picked up on the Norwegian, English, or French coasts.

Besides the small crew of Newfoundland fishermen and sealers who go with me year after year, I had this year 13 boys, mostly from preparatory schools and colleges. They take their turns along with the regular crew at all the work necessary. They are all grand lads, standing watch in all kinds of weather, and helping willingly to haul the nets, seine, and big otter trawls.

The group of boys who accompanied me this year included David C. Nutt, Dartmouth College, now making his fifth trip aboard the *Morrissey;* Arthur Manice, Trinity College, making his third trip; Albert L. Barnes, Choate School; Albert L. Hoffman, East Norwich, Long Island, making his second trip; James Pond, Jersey City, N. J.; Warren Ripley, Dublin School; Austin Colgate, Deerfield Academy; Albert Park, Mt. Vernon, N. Y.; Fred Littleton,

FIG. 50.—The *Morrissey* in the ice pack in Kane Basin, August 4-5, 1940.

FIG. 51.—A group from the *Morrissey* with a few Eskimo descending the Cape York glacier, after visiting the Peary Monument.

FIG. 52.—"Carmichael," captured from the ice pack in Smith Sound, reluctantly comes aboard.

FIG. 53.—A calm evening as we worked through the myriad bergs in Melville Bay.

Haverford Academy; George Hodge, Norwalk, Conn.; Rupert and Sam Bartlett, Methodist College, Newfoundland; and Reginald Wilcox, Hartford, Conn., making his fourth trip. Dr. Wilbur Manter, of Presbyterian Hospital, New York City, was also with us.

We cast off from the McWilliams Dry Dock at Staten Island June 20, passing through Long Island Sound and the Vineyard, following the Canadian coast, and thence to Cape Race, Newfoundland. We stopped at Brigus a day, where I visited my mother. From there we went on to Turnavik, Labrador. We intended to follow the coast, but at Port Manvers found the Arctic drift ice too heavy. I came back to the Iron Bound Islands, where we made our exit from the coast and followed the eastern edge of the ice to about 30 miles off the Baffin Island coast. From here we continued our way north, entering Greenland waters July 17 off Svarten Huk Peninsula. From the Duck Islands we worked over toward the Devil's Thumb, seeing no drift ice and few bergs. On our way through Melville Bay we spent several hours at a small group of islands known as the "Thom Islands." Very little vegetation is found there, the whole islands being covered with the nests of eider ducks and Arctic terns. The islands teemed with life, and on them we collected birds, marine life, flowers, and mosses.

From here we went to Cape York, where we built the Peary Monument in 1932. All the lads and some of the crew climbed to the summit, 1,600 feet, where they found the monument in as good condition as it was the day we finished it. There is no life on the summit, and the winds must blow violently—perhaps up to 130 miles an hour.

Our next stop was Sukat, Crimson Cliffs. The sun that afternoon warmed up the snowy slopes and small glacier, making the waterfall very effective. Millions of little auks nest upon the slopes. The Eskimo spend the summer months in their skin tupiks upon the apron of the talus, where the women and children gather with nets a winter supply of little auks.

From here we visited the Dalrymple Rock, observing and photographing birds. The burgomaster gulls that hang around feed on the eggs and young of the eider. Four times during the short stay there we saw the gulls snatch the young ducks from the mother duck's protection. The ravens also swoop down, driving the old mothers off and destroying the unprotected nests. David, who was ashore, said the "black bombers" attacked nest after nest, and in 5 minutes of intensive air raid 50 or more nests must have been destroyed, after which the black marauders shoved on to more plunder elsewhere and life resumed its normal course in the duck colony until the next

FIG. 54.—Princess Charlotte Monument, a rock with almost perpendicular sides that rises 1,500 feet in the air. Here we discovered a breeding colony of the fulmar.

FIG. 55.—On board the *Morrissey*. Jim Dooling feeding two of the four little walrus pups we brought back. The boxes were watertight and they spent much of their day swimming about the boxes and diving for their food.

attack. While some of the boys were ashore we made collections with the plankton nets, dredge, and otter trawl.

From here we visited Thule, where we paid our respects to the Governor and his wife, with whom we spent a few hours. The Governor wanted to visit Robertson Bay and I offered him passage on the *Morrissey*. Arriving at Robertson Bay, we found some old friends, among them Jim Van Hauen, who wanted some walrus meat for the Eskimo. I suggested, therefore, that he come along with me and bring the Eskimo. He did so, and in Smith Sound we got 10 or 12 walrus. I brought Jim and his Eskimo and the walrus back to Robertson Bay.

We then returned north again, into Kane Basin. We visited Dr. Kane's winter quarters at Rensselaer Harbor, also Marshall Bay, Inglefield Land, and as far east as the Great Humboldt Glacier, making observations of bird and marine life, flowers, and mosses in that vicinity. Continuing on our way north, we came to within 3 miles of Cape Lawrence, Ellesmere Land. This was the farthest north that I had ever been in the *Morrissey*. We were now 578 miles from the North Pole.

From here we worked our way south, passing through Smith Sound around the middle of August. We made the Labrador coast on the 26th and continued south to Brigus, arriving in New York September 15. All of us returned in good health and spirits, all feeling that it was a grand trip.

Besides the wide range of marine material collected for the Smithsonian Institution, we brought back four walrus pups for the New York Zoo and a polar bear, which we named Carmichael, for the Philadelphia Zoo. Collections of fauna were also made for the Cleveland Museum of Natural History and the Philadelphia Academy of Natural Sciences, as well as a collection of mosses for Vassar College.

We are now laying our plans for another trip. I think that the real fountain of youth is to be found going north every summer with such a fine group of lads as we had this year.

THE *NIMBUS* COLLECTING EXPEDITION TO THE GULF OF CALIFORNIA

By PAUL BARTSCH

Curator, Divisions of Mollusks and Cenozoic Invertebrates
U. S. National Museum

The *Nimbus,* a 36½-foot cutter owned by Russell Hawkins, Jr., manned by Mr. and Mrs. Hawkins, left San Diego Bay in December 1939 for a mollusk-collecting cruise along the west coast of Mexico and the Gulf of California. The boat was supplied by the United States National Museum with the necessary collecting equipment for such an undertaking. Of this cruise we extract certain notes from Mr. Hawkins' journal:

"Mrs. Hawkins and I stowed ourselves among the heterogeneous cargo of quinine, canned soup, and spare parts, consoled with the knowledge that any forgotten necessity could never have been squeezed aboard, for the *Nimbus* was laden 3 inches below her normal water line.

"The equipment for collecting mollusks supplied by the Museum was remarkably well adapted for such a small craft. Two 16-gallon alcohol tanks, twelve 1-gallon jars, and twenty-four pint bottles were securely packed in six wooden chests, which we fastened in the space ordinarily used as a double bunk, and unfortunately the most comfortable seat in the main cabin. Another chest, lashed to the floor under the table in the main cabin, contained two Lewis dredges, a larger dredge, spare netting, canvas, cheesecloth, and other material for preserving and identifying our specimens.

"Short-handed as we were, we nosed into every possible anchorage, and some which normally would have been impossible. So from San Diego to Cape San Lucas we had only six or seven nights at sea. One night at sea was not too bad, but two consecutive nights were, to put it mildly, very tiring. Frequent anchorages made it possible for us to dredge and explore many of the coves and bays which might otherwise have slipped by unknown. Mrs. Hawkins and I together made a heavy load for our dinghy, so usually I put her ashore, and while she searched the beach, pools, and rocks, I towed the Lewis dredge over the stern of the dinghy. The larger dredge worked well astern of the *Nimbus,* but we had to conserve gasoline and it was pretty heavy for us to handle alone, so we were able to use it only occasionally on the west side of the Peninsula of Baja California."

FIG. 56.—*Nimbus* under sail in the Gulf of California.

FIG. 57.—Mrs. Hawkins sorting the catch while under way.

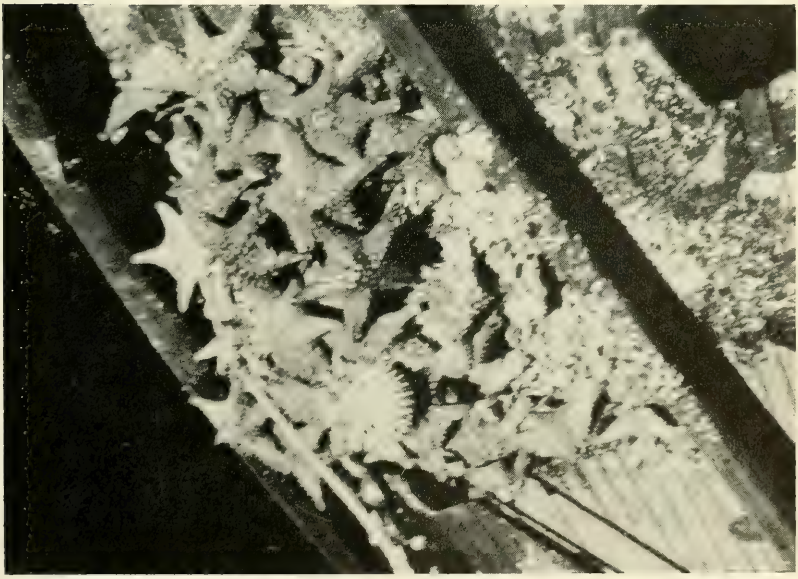

FIG. 58.—Material on deck of *Nimbus* from large dredge, before sorting. Collected near Puerto Escondida, Gulf of California.

Collections were made on the west coast of Lower California at Santo Tomas anchorage, December 22; San Martin Island, December 26-30; San Bartolome Bay or Turtle Bay, January 2-4; San Hipolita Bay, January 7; Point Abreojos, January 8, and Santa Maria Bay, January 11.

Turning into the Gulf, the expedition made collections at San Lucas Bay, January 19-21; Fraile Bay, January 24; Ensenada de Los Muertos, January 26; La Paz Bay, February 5-13; Pichilinque Harbor, February 14; St. Gabriel's Bay, Espiritu Santo Island, February 15; Isla Partida, February 16-18; San Francisco Island, February 21; San Jose Island, February 22, 23; Evaristo Point, February 24; San Carlos Bay, February 25; Carmen Island, February 26-28; Puerto Escondido, February 28, 29; Coronado Island, March 2; Pulpito Point, March 3; Conception Bay, March 6-10; Guayamas Bay (many stations), March 16-26; Puerto San Carlos, March 27, 28; St. Inez Bay, March 29, 30; La Paz, April 5, and Mazatlan, April 11-16.

The amount of work accomplished on this expedition can be partly visualized by the fact that in addition to the large amount of dried and alcoholic material, of which there are 298 lots, siftings from the various dredge hauls, filling containers ranging from 8-ounce bottles to 2-quart jars, were represented by 182 lots. One of these, taken at random, yielded no less than 78 species of minute mollusks.

To close this brief account I will give a few more extracts from the journal:

"Running along the coast of the Gulf of California, we found many rocks and islands and few lights or aids to navigation. We usually left our anchorage at dawn and tried to make our next objective before the norther regained momentum. Frequently we never started; occasionally the wind came up with the sun, so we would have to run back to our former anchorage or hope for the best in a make-shift lee behind a small island or projection from the mainland. The wind built up a short choppy sea into which it was most difficult to drive a small boat.

"When at first we went ashore I carried sidearms, expecting to be held up by the 'wild aborigines.' After meeting several of the 'wild aborigines' in their native haunts, I decided that they should have been carrying the sidearms. More particularly on the Peninsula we found the Mexicans friendly and kindly and we thoroughly enjoyed our grotesque conversation with them, part Mexican, part English, sometimes mostly signs and smiles. We found warm welcome wherever we went. We will long treasure many fond memories of our friends in the Bay of California."

BUTTERFLIES OF VIRGINIA

By AUSTIN H. CLARK
Curator, Division of Echinoderms, U. S. National Museum

Life is always changing, never static. So in considering the butterflies of Virginia it is necessary to note the changes that take place from year to year—changes in abundance, in range, and in form. Some butterflies are disappearing from regions where once they were common. Others are increasing in numbers. Still others from time to time have entered the State from more or less distant regions and have made themselves thoroughly at home.

Two such recent immigrants are now perhaps the commonest and most generally distributed species in Virginia. It is possible that they are exceeded in actual numbers by two small and inconspicuous ones, the pearl-crescent (*Phyciodes tharos*) and the tailed blue (*Everes comyntas*); but if not the most numerous of Virginia butterflies they are certainly the most conspicuous. One of these is the cabbage white (*Pieris rapae*) of Europe which was first noticed about 1870 in Surry County, and the other is the orange clover butterfly (*Colias philodice eurytheme*) that entered the State from the west and south about 20 years ago (figs. 60, *b*; 61, *a*, *b*).

The orange clover butterfly was wholly unknown in Virginia prior to 1920, when Dr. Frank Morton Jones captured one on the Delaware-Maryland-Virginia peninsula. By 1923 it was common as far north as Wachapreague on the Eastern Shore, where it had replaced the native yellow clover butterfly (*Colias philodice philodice*) (fig. 60, *a*) and to the north it occurred as far as Berlin, Md. In 1925 it was found in the Dismal Swamp, though there were still no records farther west. However, by 1929 it was abundant in the west as far north as Lexington, occurring in lesser numbers farther north, and it was also common in the Kanawha and other valleys in West Virginia where previously it had been unknown. Since then it has swept over the entire State (fig. 59), where it is now thoroughly established everywhere except only in the highest mountain pastures where its yellow eastern relative still is common.

With the increase in numbers of this intruder the numbers of its native yellow relative diminished. Now this yellow butterfly, which 20 years ago was the commonest and most conspicuous butterfly of Virginia's fields and pastures, has in most regions almost disappeared.

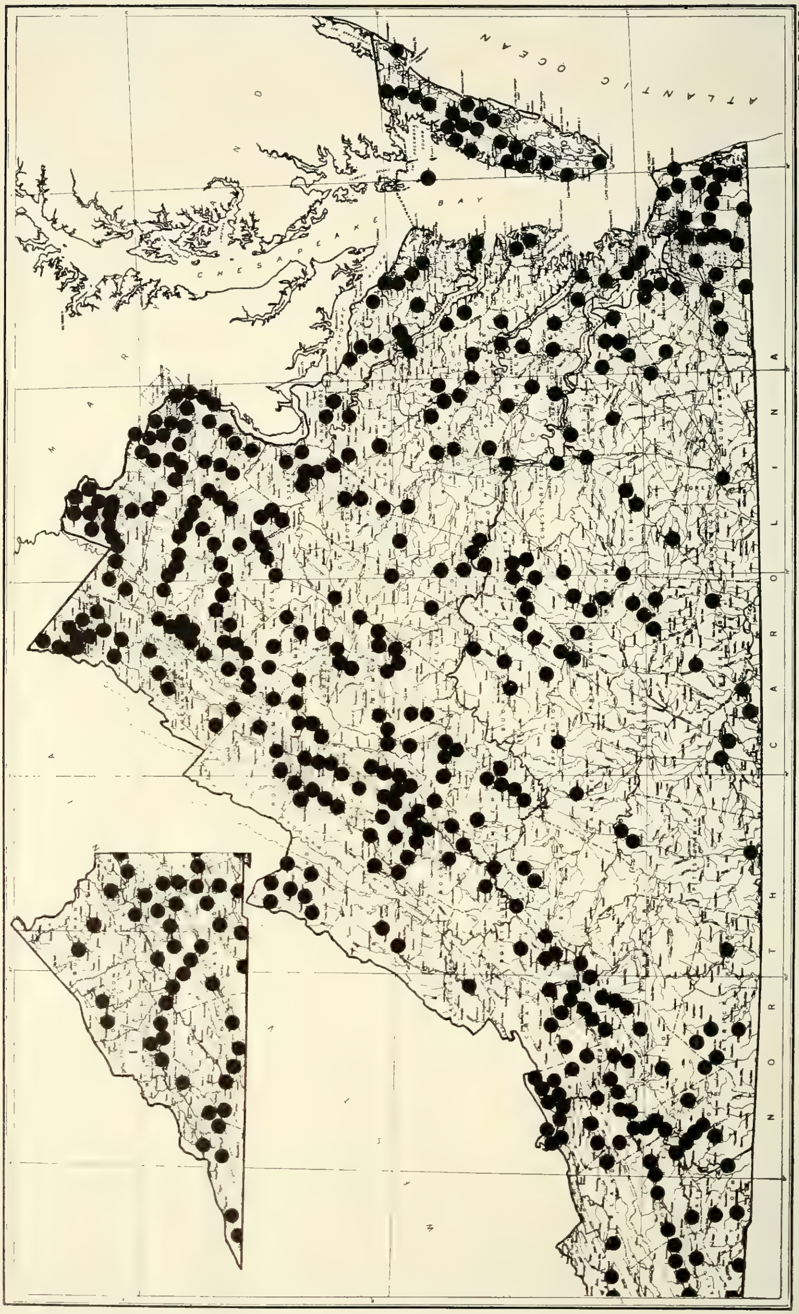

FIG. 59.—Map showing the localities in Virginia where the author has found the recent immigrant, *Colias philodice eurytheme.* Less collecting has been done in the south-central portion of the State than elsewhere.

FIG. 60.—*a,* yellow clover butterfly (*Colias philodice philodice*), large male, Silver Spring, Md., Aug. 3, 1927; *b,* orange clover butterfly (*C. p. eurytheme*), a yellow female slightly tinged with orange, Cabin John, Md., Sept. 14, 1928.

FIG. 61.—Orange clover butterfly (*Colias philodice eurytheme*): *a,* small pale male, Silver Spring, Md., July 23, 1927; *b,* large deep orange female, Cabin John, Md., Sept. 14, 1928.

FIG. 62.—*a, Hesperia attalus,* male, under side, St. Petersburg, Fla., Apr. 24, 1914; *b, Atrytone conspicua,* male, Beltsville, Md., July 15, 1928; *c,* same species, under side.

Just why the numbers of these two closely related butterflies should vary reciprocally is not known.

The disappearance of the yellow clover butterfly was only one of the curious adjustments that took place as a result of the immigration of the orange form into this region. In the early years of its occurrence in Virginia the intruder appeared first in the latter part of April, and the earliest individuals were orange, like those seen in summer but somewhat smaller. In 1931 it appeared earlier than it had in previous years and in a different color. The early individuals (fig. 61, *a*) were small and clear yellow with a slight flush of orange on the inner and lower portion of the fore wings instead of orange. Since then this small light form has appeared regularly in early spring, usually early in April, in some years even in late March.

In the West, spring individuals are small and yellow with a slight flush of orange, the next brood is larger and wholly orange, and the summer broods are still deeper orange (fig. 61, *b*). In Virginia a few orange individuals fly in spring with the small yellow ones, and in summer and autumn all three forms fly together. So if we regard the conditions in the West as representing the standard pattern, this butterfly has not as yet become fully adjusted to its surroundings in Virginia.

In 1937 bright clear yellow individuals of this butterfly somewhat suddenly increased in numbers, and they have been common ever since. In that year also this insect first adopted the habit, so characteristic of its eastern yellow representative, of sitting in sociable companies on mud and sucking up the moisture.

What further changes may take place in the habits or forms of this interesting butterfly we cannot guess. But its curious history in the past indicates that it will be worth watching in the future—always with the hope that in Virginia it will not develop into the destructive pest that it is in the irrigated lands of California and Arizona.

Of the disappearing butterflies the most conspicuous is the diana fritillary (*Argynnis diana*), the range of which is becoming more and more restricted. During the past season we obtained records of this species from Buchanan, Tazewell, Wise, and Botetourt Counties, from which it was previously unknown.

Two new butterflies were added this year to the Virginia list. Carroll E. Wood, Jr., and Lloyd G. Carr took *Atrytone conspicua* (fig. 62, *b, c*) near Mountain Lake in Giles County, and Frank W. Trainer captured *Hesperia attalus* (fig. 62, a) at Farmville; I caught another of the latter species at Clarks Gap in Loudoun County.

STUDYING THE GRASSES OF VENEZUELA

By AGNES CHASE

Custodian, Section of Grasses, U. S. National Museum

Last January I received an invitation from the Venezuelan Ministry of Agriculture to visit Venezuela to study the grasses and to suggest methods to further the study of the Gramineae. The Ministry had, from time to time, extended similar invitations to other botanists and to zoologists. The boat I was on stopped at Curaçao for about 4 hours, giving opportunity for a brief collecting trip. Landing at La Guaira, Venezuela, February 28, I proceeded directly to Dr. Pittier's laboratory in Caracas.

La Guaira, the port of Caracas, lies at the foot of the seaward face of the Cordillera de la Costa (fig. 63). Caracas is only 8 miles distant, but the steep winding road is 23 miles long, in many places cut out of the face of the cliffs (fig. 64). Dr. Henri Pittier, director of the Servicio Botánico of the Ministry of Agriculture, has been the outstanding botanist of Venezuela for 23 years (fig. 65). For 17 years before that he was in the United States Department of Agriculture. He has been instrumental in assuring the preservation of an extensive area of cloud forest in the state of Aragua, the Parque Nacional, and in bringing about the enactment of laws forbidding the burning of the wooded slopes and the grassy plains.

After a day's botanizing in the foothills of the coast range I had opportunity to make a trip by motor car to Mérida in the high valley between the two ranges of the Andes, the Sierra del Norte and Sierra Nevada de Mérida, studying and collecting grasses en route. The roads, where completed, winding up the steep mountain sides, are marvels of engineering. It was near the end of the dry season and the whole country was suffering from drought, but this is the flowering time of some of the trees, and the slopes were aglow with the golden flowers of *Tecoma chrysantha,* the orange-red flowers of species of *Erythrina,* and the flowers of many other trees and shrubs only slightly less gorgeous. The Andes are not wooded, open stony grassland extending to the páramo, where the truly alpine flora occurs. Below the páramo the steep stony slopes were beset with *frailejones,* species of *Espeletia,* a tall composite with a mass of woolly foliage at the base, thick leafy stems, and masses of old flower heads at the summit, the whole a woolly brown. "Frailejones" means big brothers or monks, these great plants marching up the slopes having sug-

gested a company of monks to some early giver of common names, for the same name is used in Ecuador and Peru.

Some few kilometers before we reached the pass, frailejones disappeared and patches of *Aciachne pulvinata* began. About Alto del Aquila (so named for the great bronze condor surmounting the monument to Bolivar), the highest part of the road, *Aciachne* is the dominant plant, with patches 10 to 20 feet in diameter forming the densest cover. This grass, occupying windswept heights, is marked by extreme reduction. The stems are an inch or two high, the stiff rolled blades are about a quarter of an inch long, and the inflorescence is reduced to a single spikelet (rarely two or three). The flowers are close-fertilized, the horny lemma tightly enclosing the pistil and the minute stamens and never opening. In the wind-swept páramo ordinary wind-pollinated grasses must waste an enormous amount of pollen; *Aciachne* avoids this. The tip of the lemma, though short, is as sharp as a needle and attaches the seed to any passing animal.

The monument to Bolivar bears an inscription (freely translated) "Here, under the breath of war, crossing forests and climbing mountains, passed liberty."

On the descent the country was much the same but less sparsely inhabited. Wheat was being harvested, cut by hand with small sickles. The stone-walled fields are so full of boulders it would seem impossible to grow anything in them, but we saw wheat being threshed in round stone-walled enclosures by horses driven round and round. The grain was winnowed by being tossed in the air in flat baskets. The straw was piled in larger square stone-walled enclosures. We saw a steep slope being plowed, an ox pulling a narrow-bladed plow (wood, edged with iron)—not a plowshare that turns soil, but a blade only scratching the surface—with two men guiding or helping. Pico Bolivar (16,256 feet), in Sierra del Norte, and Corona (16,000 feet), in Sierra de Mérida, both snow-crowned, were in sight until we neared the city of Mérida. This, the principal city of the Andes, lies at 5,300 feet elevation. The population of the state is about 17,900. There was a surprising amount of gardening and farming in this little mountain valley. The city, founded in 1558, has a university that dates from before the landing of the Pilgrims at Plymouth. We spent one night at Mérida and started back before dawn the next morning. Clouds obscure the pass except in the early morning, and motorists aim to cross the pass by 9 o'clock. The whole trip took 6 days, and I found interesting grasses in spite of the drought.

I had several days' botanizing in the Federal District and in the hills and cloud forests of the Cordillera de la Costa. In the vicinity

FIG. 63.—La Guaira, port of Caracas.

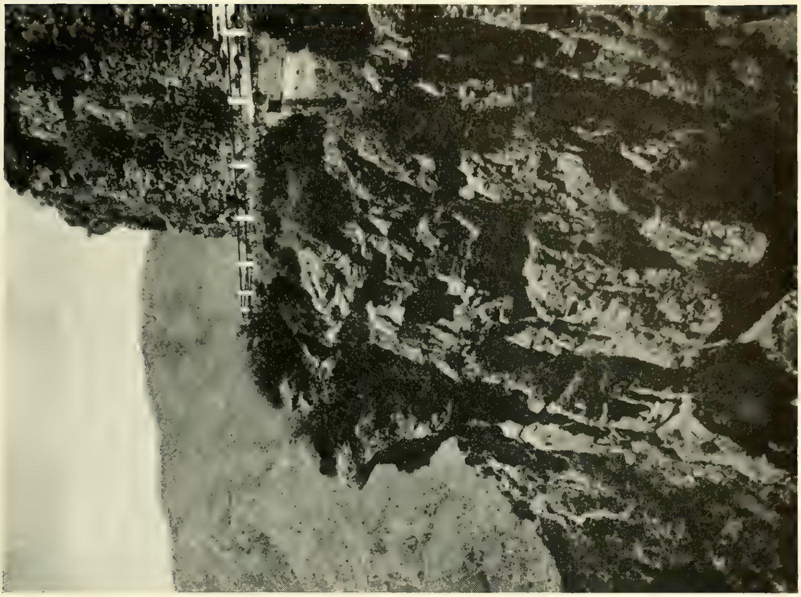

FIG. 64.—Motor road to Caracas.

of Caracas and eastward "caña brava," *Gynerium sagittatum,* a grass 20 to 30 feet tall, is conspicuous along the streams and in moist ground. It is an unsurpassed soil-binder and is extensively used for roofing. The walls of native huts are commonly built of the canes (fig. 66), sometimes overlaid with sun-baked brick.

On March 20 Dr. Pittier, his assistant, Miss Luces, and I left La Guaira for the Oriente, as the eastern part of Venezuela is called. The next day we reached Guanta, a little west of Cumana, where Humboldt and Bonpland collected. After passing the low coral hills of the coast, we rode for some 5 hours across the flat plains, which, broken by a few low mesas, extend to the Orinoco. We made our headquarters at San Tomé, Estado Anzoátigui, the headquarters of the Mene Grande Oil Company (a subsidiary of the Gulf Oil Company), near Río Tigre. The region is a flat, wind-swept savanna with scattered low trees mostly bent toward the west. Much of the grassland has been burned year after year, and the soil is terribly eroded, the fine topsoil entirely gone, exposing the coarse gravel in many places. Tiny hummocks of *Oncostylis paradoxa,* a sedge with short, curled foliage, clung to the earth with 2 or 3 inches of burned base exposed by wind erosion. The dominant grasses, those that have withstood repeated burning, are *Trachypogon plumosus,* originally described from Cumana, *Axonopus anceps,* both coarse and hairy, giving a grayish cast to miles of the llanos, *Paspalum Gardnerianum,* and species of *Aristida.* There were many less abundant grasses, all suffering from the severe drought. These exceedingly dry llanos are flooded during the rainy season, the water, from the Orinoco far to the south, standing a foot or more deep. The surface soil is a fine silt. The land is so flat there is relatively little evidence of the results of water erosion, such as gullies and badlands, the water soaking into the coarse gravel. The best collecting was in the black mucky ground bordering the morichales, groves of Moriche palm (*Mauritia flexuosa*) along the rivers. Here I found four grasses new to Venezuela, besides an undescribed species of *Mesosetum.* In a favorable season the San Tomé region would be well worth exploring.

After about a week here we left for the northeast. Some 60 kilometers east low mesas begin, badly gullied and deeply cut. There are broad sandy river bottoms, and two wide canyons of red rock or clay, sculptured like miniature Grand Canyons. Toward Maturín the trade winds are much less severe and the country is cultivated. East of Maturín I found a bamboo in flower which turns out to be *Guadua paniculata* Munro, described from Brazil, and known from but three collections. Northeast of Maturín the country is protected

FIG. 65.—Dr. H. Pittier.

FIG. 66.—Native hut with walls of *Gynerium sagittatum* and roof thatched with palms.

by the coast range. At Caripito it is no longer llano, but cleared jungle and second-growth forest, the land cultivated and very weedy, less interesting than the llanos.

Returning to San Tomé, Miss Luces and I were taken by motor to Ciudad Bolivar on the Orinoco. The country became more and more desolate, with some thorn bush and cactus as we neared the river. Our school books tell of rich land "watered by rivers." The Orinoco, like the São Francisco of Brazil, does not water the land through which it flows. The land along the Orinoco, the deepest river in the world, was dry to the very brink. It was low water, the banks of fine silt rising 50 feet above the water, bare save for a few patches of a sedge, and some *Reimarochloa brasiliensis* and *Eragrostis hypnoides*—grasses.

We returned to Caracas overland, about 600 kilometers, taking 2 days over roads deep in loose sand and full of gullies. There were much thorny bush, tall cactuses, and palm barrens (*Copernicia tectorum*).

Venezuela was formerly a cattle country, with large export trade, but cattle raising has been to a great extent abandoned. Venezuela has very extensive oil fields. There are oil wells around Maracaibo and in the lake itself, and the whole east, between the Coast Range and the Orinoco, is rich in oil. The law requires the oil companies to employ three Venezuelans to one foreigner, and to provide the camps with good water, electric light, and sanitation. No wonder people left uncertain cattle raising to work for the oil companies, with water, schools, and some of the larger ones provided with hospitals. Venezuela has a small population, less than 5,000,000, including the Indians south of the Orinoco, so that the demand for workers at oil camps has almost depopulated the interior. The result is that a great deal of food has to be imported and living is exceedingly expensive. Both the oil companies and the federal government are interested in establishing farming and cattle raising on modern methods.

In spite of the drought my visit was interesting and profitable, many little-known grasses being collected, 11 previously unknown for the country, and 1 undescribed. In my report to the Minister of Agriculture I said that Venezuela needed a specialist in grasses and suggested that Miss Zoraida Luces, who had begun the study of grasses by herself, be sent to study grasses in the Grass Division of the United States National Herbarium for a year. The suggestion was favorably received, and Miss Luces reached Washington in September and is now engaged in a work on the genera of grasses of Venezuela.

AN OSSUARY AT THE INDIAN VILLAGE SITE OF PATAWOMEKE (POTOMAC)

By T. D. STEWART
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U. S. National Museum

During the latter part of the field season of 1939 an ossuary was discovered near the center of the historic Indian village site on Potomac Creek, in Stafford County, Va., known as Patawomeke. Circumstances prevented the exposure at that time of more than a third of the skeletal remains. Although these remains were not too well preserved, owing perhaps to the weight of the superimposed earth and its heavy clay consistency, the arrangement of the bones and the meager accompanying cultural material furnished important new information regarding local burial customs. The complete examination of this ossuary, then, was the primary reason for spending another field season at this site. Secondarily, we wished to search the neighborhood for related sites.

A trip to the site in May of 1940 revealed that the field in which the ossuary was situated had just been planted in corn. This circumstance dictated the date for beginning operations there, namely, in the fall after the corn was cut. James Ashby, the owner of the farm, again kindly gave permission to excavate. Arrangements were made also for Karl Schmitt, Jr., and Chandler Rowe, graduate students of the department of anthropology, University of Chicago, to serve as assistants.

We set up camp on August 20 and were immediately adopted by a kitten that had wandered away from the farmhouse and was living in the cornfield. "Ho cat," as he was called, besides furnishing entertainment and company, served us well by keeping the tents free of crickets and grasshoppers, a diet upon which he seemed to thrive.

From this headquarters we made daily trips over a period of a week—until the corn was cut—to various points along the Rappahannock River in search of Indian sites showing relationships to Patawomeke. Although we had the advantage of Mr. Bushnell's reports on this part of the river, the season was unfavorable for such investigations; many of the sites were under cultivation. Nevertheless, we became convinced that a Rappahannock type of pottery constitutes a minor element at Potomac Creek.

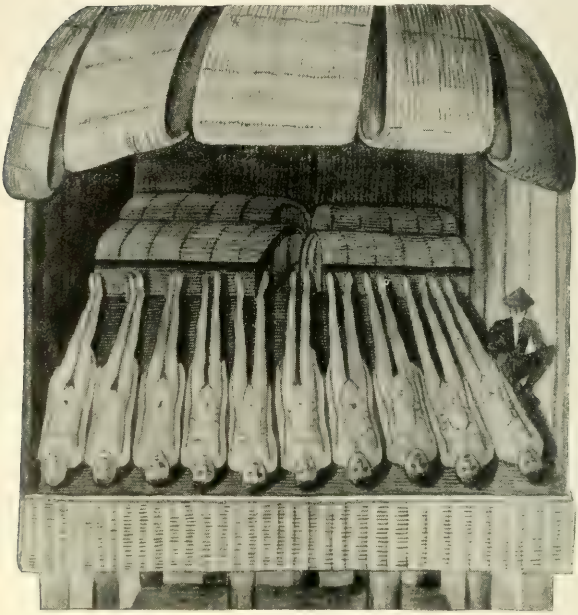

Fig. 67.—Detail of John White's drawing of a "tombe" or death house seen along the North Carolina coast in 1585. Note how the extended position of the bodies corresponds to that of the skeletons found in the ossuary (fig. 69).

Fig. 68.—Fragment of Indian skull containing mud dauber nest. Access to the nest was through the opening for the spinal cord as indicated by arrow. The presence of the nest in the skull proves that the latter, in the dried state, was exposed in the open before burial.

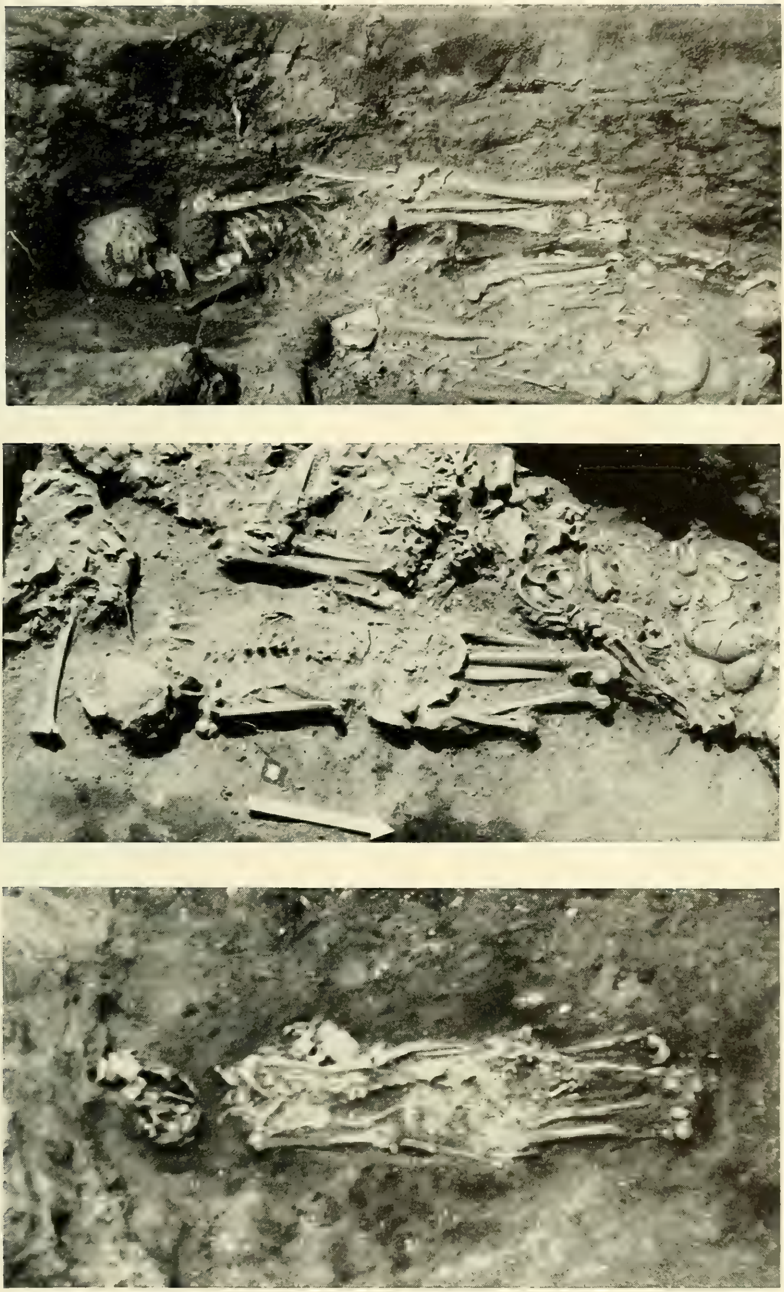

FIG. 69.—Three articulated skeletons exposed in the ossuary by the removal of adjacent and superimposed bones. Although these bodies were laid face down in the grave, it is believed from the unnatural position of the lower legs that they were originally on their backs in a death house.

Very few details have been recorded of the burial ceremonies of the Virginia tidewater Indians. Capt. John Smith mentions the exposure of bodies in a "Tombe, which is an arch made of mats, [where] they lay them orderly." Such a death house, as seen by the artist John White along the coast of North Carolina in 1585, is illustrated in figure 67. This "tombe" apparently was restricted to prominent individuals. How the bodies of this group were finally disposed of is uncertain, for Captain Smith distinguishes the grave pits as "for their ordinary burials."

The work this season at Patawomeke has a bearing on these points. Of the approximately 100 skeletons encountered in the ossuary, the majority had become or were disarticulated before burial. A few—approximately a dozen adults—however, were observed to be fully articulated (see fig. 69). These articulated skeletons were found on the bottom or along the sides of the pit and hence may have been the first bodies received into the grave. Moreover, these articulated skeletons all are possibly males and have their arms extended along their sides as do the bodies pictured in White's death house (fig. 67). Also, all of these skeletons have their lower legs flexed unnaturally forward, which would have been a practicable way of shortening an extended body resting on its back.

There is evidence, on the other hand, that the disarticulated skeletons were exposed for a considerable period before burial; in several cases mud dauber nests were found in the skull (fig. 68) or among the bundled bones. This finding indicates that the period of exposure included at least one warm season. Incidentally, these mud dauber nests, which are surely over 300 years old, have been positively identified as to species (*Sceliphron caementarium* (Drury)) by R. A. Cushman, of the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, through their typical form and the remains of the larvae found within the cells.

Another large mass of charred bones was found this year, and at the opposite end of the pit from that of last year. These bones, which were clearly the remains of several individuals, including children, had been placed on the sloping side of the pit probably at an early stage of the filling. Among these bones were burned beads of various sizes and one fine pipe bowl.

With the exception of this pipe and an occasional potsherd, the only grave goods with the skeletons were beads and pendants or gorgets. A small amount of copper found with several individuals suggests that this ossuary may date from the early historic period. Many other points of interest undoubtedly will appear when the collections are studied.

IN SEARCH OF CORONADO'S "PROVINCE OF QUIVIRA"

By WALDO R. WEDEL

Assistant Curator, Division of Archeology, U. S. National Museum

In the summer of 1541 the buffalo plains stretching hundreds of miles northeastward from Pecos were traversed for the first time by white men. Behind Coronado and his Conquistadores lay the disillusionments of the Seven Cities of Cibola; ahead, the fabled riches of Quivira. By the end of summer this dream, too, had faded. Instead of a great and wealthy kingdom, the Spaniards found themselves in a land dotted with grass-house villages whose simple peaceful inhabitants supported themselves by hunting and by cultivation of maize, beans, and melons. The land was "very fat and black," but of gold and silver there was none. In spite of the disappointing results of this and subsequent adventures, a belief in the riches of Quivira lingered in the Spanish mind. As late as 1696, soldiers in pursuit of fugitive puebloan groups at El Cuartelejo on the western plains found them in possession of copper and tin said to have been obtained by journeys eastward to the wealthy and civilized province of Quivira. The exact location of the province remained indefinite, but the name gradually shifted westward until it came to rest in eastern New Mexico. It is now generally believed that the natives of Quivira were the Wichita Indians; the province, as of Coronado's time, has been variously located from Oklahoma northward. Since 1927 the presence of large village sites of apparent protohistoric age near the great bend of the Arkansas River in central Kansas has led local historians to renew their claims that here lay Coronado's Quivira. Archeological verification, however, has been lacking.

Several promising sites occur along Cow Creek and Little River in Rice County, and to the east. Four of these have each a large depressed circle with mounded center. Locally termed "council circles," one which was partly excavated by the United States National Museum in 1940 included curved basins (fig. 71, right) with postholes, fireplaces, burnt roofing clay, refuse, and in one case, disarticulated human bones. Purpose of the structures indicated is unknown. Otherwise, there was no certain evidence of house sites, but numerous large storage pits and refuse mounds argue for a relatively permanent occupation. Charred corn and wild fruit pits, along with quantities of bison, antelope, and other bones show that sub-

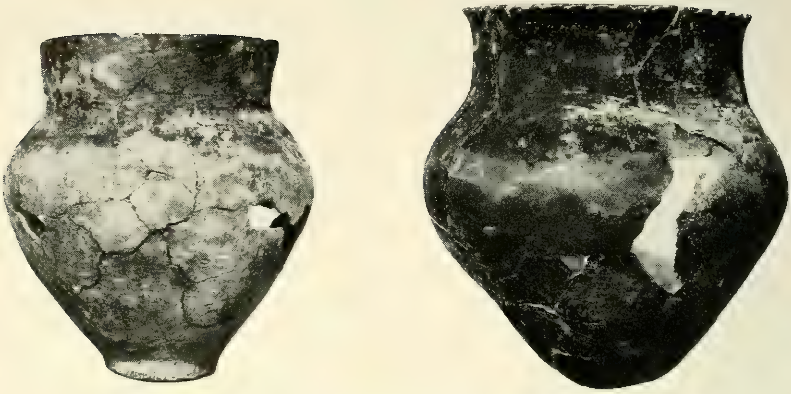

Fig. 70.—Restored pottery vessels from the Tobias village site, Rice County, Kans.

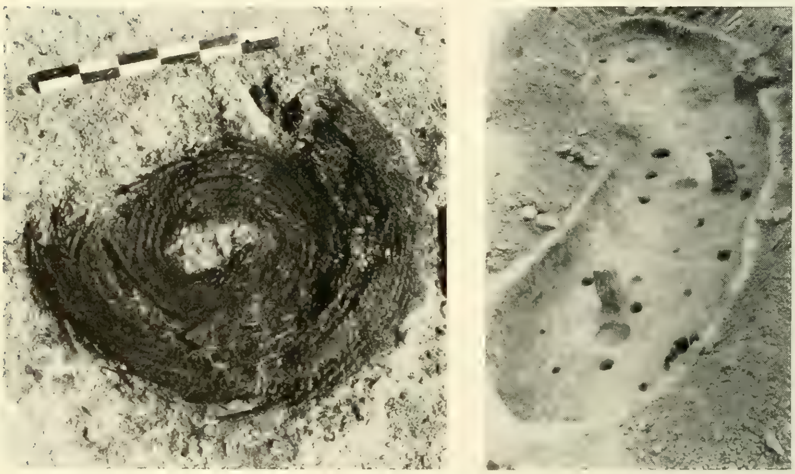

Fig. 71.—Left, remains of a coiled basket preserved by charring, Tobias site; right, curved basin, apparently the remains of an earth-covered structure of unidentified purpose. Tobias site.

FIG. 72.—Excavating a small mound on the Arkansas City Country Club property in Cowley County, Kans. From a cache pit below this mound came a pueblo sherd dated ca. 1525-1650.

FIG. 73.—Petroglyphs of uncertain age at Spriggs Rocks near Little River, Rice County, Kans.

sistence was based partly on horticulture, partly on hunting and gathering. Pottery of distinctive type—grit-tempered, often with paddle-marked surfaces and loop handles—was plentiful (fig. 70). Also abundant were small triangular flint arrowpoints, end scrapers, knives, drills, arrowshaft smoothers, grooved mauls, and mealing implements. Bonework included awls, needles, stemmed projectile points, fleshers, wedge-shaped paint "brushes," arrowshaft wrenches, and unidentified forms. There were well-turned L-shaped pipes of red sandstone, and finely chipped blades of chert. Outstanding finds include a coiled basket (fig. 71, left) preserved by charring, and the remains of a necklace of blue glass, bird bone, and turquoise beads. Far-flung trade contacts are evidenced by obsidian from Yellowstone or the Southwest, by turquoise and glazed-ware potsherds from New Mexico, by banded chert from aboriginal quarries near Maple City, Kans., and Hardy, Okla., and possibly by other items. There is some reason to believe that secondary burial of the dismembered dead, possibly in special structures, was practiced.

Glass, iron, and similar evidence of trade with white men was extremely scanty. Puebloan sherds from storage pits and middens have been identified as late Rio Grande glaze-ware types dating from 1525 to 1650. A badly rusted mass of interlocking iron rings, identified as chain mail, may or may not be attributable to Spanish contact.

Excavations in the Walnut Valley near Arkansas City showed that similar remains exist here. There were no house or burial sites, but among the artifacts taken from storage pits were additional puebloan sherds (ca. 1525-1650). Lack of time prevented more than a brief test at a large and very promising mound site on the river bluffs east of Arkansas City (fig. 72). Throughout, it should be noted, there was a gratifying willingness on the part of landowners and others to cooperate in the work.

Despite their preliminary character, the investigations show that in very early historic days central Kansas from Rice County east to Marion County and south to Oklahoma was dominated by a semisedentary, partly horticultural people with a comparatively uniform and somewhat distinctive material culture. The marked scarcity of European trade goods, coupled with the rare but consistent occurrence of datable pueblo sherds, suggests that these sites may have been inhabited during the period of Spanish exploration in the sixteenth and early seventeenth centuries. Further detailed studies may strengthen the growing suspicion that they are of Wichita origin and possibly represent some of the Quivira villages seen by Coronado, Jumana, Bonilla, and Oñate.

TRAILING EARLY MAN IN VIRGINIA

By DAVID I. BUSHNELL, Jr.
Collaborator in Anthropology, Smithsonian Institution

The search for tangible evidence of early man in Virginia led me to make several trips during the summer and fall of 1940 to the vicinity of the Peaks of Otter, in Bedford County, a few miles south of the James River. The visits proved both successful and interesting. Here, in a little valley along the northern base of Sharp Top, the lower of the peaks, were discovered traces of a remote settlement, and as it was partly on the property of the Hotel Mons it will be called the Mons site. The area has recently been crossed by the new Skyline Drive, and much of the ancient site was covered and graded during the construction of the roadway.

The valley, a beautiful secluded spot through which flow small streams and with springs of clear, cold water, had been occupied many times during past centuries—from the early period when it was entered by wandering bands to whom are attributed the Folsom points and certain other types of artifacts found scattered over the surface. Countless centuries must have intervened between the coming of these primitive hunters and the arrival of the historic Cherokee who occupied a village near the peaks in late protohistoric times, and whose word for mountain, Ottare, is believed to have been rendered Otter by the European colonists.

Many forms of stone implements and weapons, bits of pottery, and fragments of steatite vessels have been collected on the site. It is easily conceived that the innumerable objects were made during distinct periods of occupancy, and that some pieces are much older than others.

Two Folsom points, or rather parts of points, have been found on the Mons site mingled with the later material. One specimen is the concave base end of a point made of grayish chert. The second example is made of a very dark quartz schist, now altered to a light color. This is shown, natural size, in figure 78. Other pieces from the site are included in the illustration; all are made of dark or black stones now weathered to a light gray, and all may be equally old.

Beautiful examples of Folsom points have been found in Bedford County away from the Mons site, but all have been encountered in fields or on hillsides, with no traces of camps or villages nearby. One

FIG. 74.—Peaks of Otter, Bedford County, Va., looking north. Sharp Top on left, 3,875 feet high. Flat Top on right, 4,001 feet high.

FIG. 75.—On west side of valley of Little Stony Creek, about 2 miles southeast of Sharp Top. A large Folsom point made of red jasper was found near tree indicated by white arrow.

FIG. 76.—Part of Mons site in foreground, looking south over new roadway showing north side of Sharp Top.

FIG. 77.—Part of Mons site looking northeast, from north of new roadway.

large point made of red jasper was discovered on the west side of the valley of Little Stony Creek, about 2 miles below the Mons site, and others of equal interest have been found at a greater distance from the peaks.

FIG. 78.—Five specimens from the Mons site, all made of dark or black stones now altered to a very light color. Folsom point on left with missing parts indicated. Small flake-knife below. Natural size.

Thus it is evident that the region surrounding the Peaks of Otter, where the valleys and mountainsides were covered with dense forests and where game was plentiful, had attracted the first nomadic hunters who entered the wilderness. Later, during succeeding centuries, other tribes came to occupy the region—tribes that differed in manners and ways of life. Stone implements made and used by the many occupants of the valley are now found where they had been lost or abandoned, but the identity of their makers remains unsolved.

LATEST EXCAVATIONS AT LINDENMEIER SITE ADD TO INFORMATION ON THE FOLSOM COMPLEX

By FRANK H. H. ROBERTS, Jr.
Archeologist, Bureau of American Ethnology

Evidence that Folsom man, one of the first American big-game hunters, made and used fine bone needles with eyes, and that three types of projectile points found in the western part of the Great Plains represent sequent stages in the occupation of the area was part of the information obtained by the Bureau of American Ethnology-Smithsonian Institution expedition in northern Colorado during the 1940 field season.

Excavations at the Lindenmeier site (fig. 79), an important archeological location because it once was a camping place for groups of Folsom people, were resumed June 3, continued through July and August, and were brought to a close on September 20. The summer's digging started at a portion of the site where work stopped the previous year (fig. 80) and the overburden, ranging from 3 to 6 feet in depth, was removed from 2,125 square feet of the former habitation area. This exposed numerous concentrations of cultural material consisting of stone and bone implements and camp debris (fig. 81). Over 1,000 artifacts, the largest number obtained during any single season's excavation at the site, and numerous animal bones came from these assemblages. Included in the collection of artifacts are bone needles, mentioned above, bone awls, bone punches, bones with spatulate ends, stone projectile points, many of the flakes removed to form the facial grooves, scrapers of various kinds, knives, hand hammerstones, and stones used for smoothing wooden objects and, possibly, for dressing skins. One interesting occurrence was the finding of a channel flake that fits a portion of a point obtained during the first season's work. The fragments came from locations some 450 feet apart.

The importance of the needles is that they demonstrate the presence of this type of implement at an earlier period in North America than previously supposed and also in their implication of the use of some kind of tailored clothing and foot gear. While there was the assumption that Folsom man relied on hides from the animals he hunted for protection against the rigorous climate of the closing days of the last ice age, this is the first indication that he may have fashioned actual garments from that material. With such needles and

Fig. 79.—Approaching thunderstorm at the Lindenmeier site, northern Colorado. Main portion of site lies between camp at the left and hill at the right.

Fig. 80.—Looking south across the Lindenmeier site. The 1940 excavations were above the ravine bank near the right border of the photograph; expedition camp at the left.

Fig. 81.—A portion of the excavations. Workmen at the right are just beginning to remove the specimen-bearing stratum.

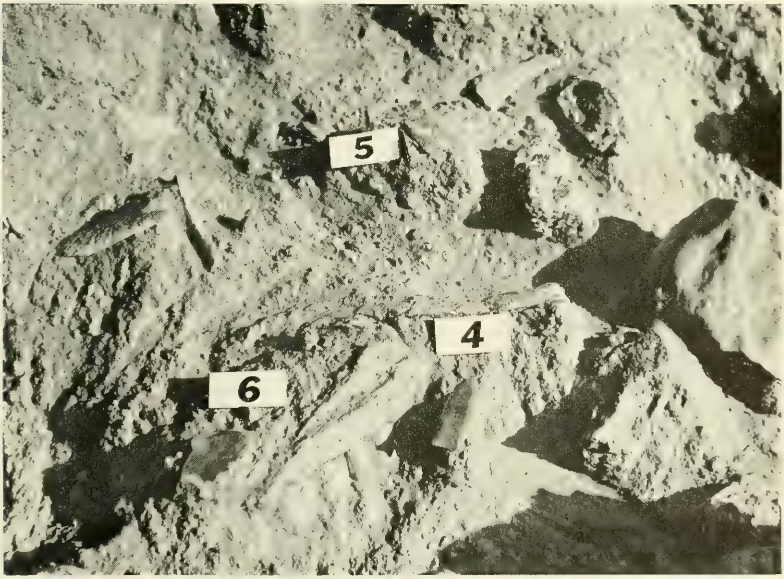

Fig. 82.—Archeological objects and pieces of cut bison bones in situ. 4, a characteristically fluted Folsom point; 5, the basal portion of a broken point; 6, a stone scraping tool. Portion of bison jaw lies between 4 and 6.

sinew for thread a serviceable job of sewing was possible. The needles apparently were made from splint bones from deer or bison.

The three types of projectile points are the characteristically fluted Folsom (fig. 82) ; a point that in its general outline resembles the Folsom but has only a thinned base formed by the removal of several short, narrow flakes instead of a single broad, long one as in the case of the Folsom; and a triangular-bladed form with a long, broad tang. They occur in the preceding order with the Folsom at the bottom, the oldest level. The significance of this evidence is that it establishes the priority of the Folsom type. On the basis of typological studies it has been suggested that the thinned-base type was a preliminary stage in the development of the facial fluting typical of the Folsom points, but it now appears that it represents a break-down in the form. The type with the long, broad tang occurs in a distinct stratum that is definitely later in time than the Folsom horizon. Similar points have been found at several sites in western Nebraska and Kansas and have been regarded, by some investigators, as contemporary with the Folsom. This is now disproved.

In addition to the above-described work, nine test trenches were dug in portions of the site not investigated previously. None of these revealed promising locations for further excavations, and the openings were not enlarged. Evidence obtained from many test pits, those put down in previous years as well as those of the current season, indicates that the area where the major digging was done was the main camping place on the old valley bottom.

During the month of August the writer supervised student excavations at the University of New Mexico field session in the Chaco Canyon, N. Mex., and visited several sites in New Mexico and Arizona where reports indicated the possibility of relatively early occupancy. The most important of these is one located south of the town of San Jon, approximately 25 miles southeast from Tucumcari, in eastern New Mexico. There large numbers of cut and split animal bones, most of them in an advanced stage of fossilization, are weathering from deposits along the edge of the Staked Plains. Associated stone flakes and artifacts indicate a former hunting grounds or camping place. Projectile points from the assemblage suggest an early Yuma type, and it is possible that valuable information on the proper place in the archeological picture of the area of that much-debated form could be obtained by careful excavation of the site. While the writer was absent from the Lindenmeier site, work continued under the supervision of Charles R. Scoggin, a student from the University of Colorado, who has been a member of the field party during all but one of the several seasons of excavation there.

RECORDING CULTURE CHANGES AMONG THE CARRIER INDIANS OF BRITISH COLUMBIA

By JULIAN H. STEWARD
Senior Anthropologist, Bureau of American Ethnology

Persons who believe that anthropologists are strange, antiquarian scientists who prefer skeletons to living people and the dust and decay of past ages to things living and modern, may be puzzled that an anthropologist should deliberately choose to study an Indian tribe that had abandoned 90 percent of its native customs in favor of "civilized" ways of life. Yet studies of acculturated tribes have become a major field of research and fit neatly within the scope of the "science of man." Anthropology directs only part of its attention to the past, which it sees as a background to the present. It views contemporary primitive peoples as very live groups, whose cultures, though rooted in history, are not relics of the past but are present realities that function and develop today in the ever-changing medium of the modern world. The anthropologist studies these modern primitives to gain insight into social change and to test social theory.

Particularly well suited for studies of culture change are the Carrier Indians of central British Columbia. It was known that the social organization of these Indians had been fundamentally altered twice in the past. In prehistoric times the Carrier had substituted a complex society copied from that of the coast Indians for their own simple organization. After the white man came, their social structure was revolutionized again through contact with civilization. By what processes were these changes effected? What relation had economic pursuits to social organization? In the present Carrier culture, what is Indian, what is White? The writer visited the Carrier during the summer of 1940 to gather information required to answer these questions.

The Carrier country is still a vast wilderness of lakes and forest-covered mountains. Except for the Canadian National Railway that runs through it to the Pacific coast, a little precarious farming south of the railroad, and scattered mines in the "bush," it is unchanged by civilization. The Indian population continues to live mainly on the resources of forest and stream: Deer, bear, caribou, and moose, salmon and trout, some of the latter weighing up to 18 pounds, and

FIG. 83.—A Carrier woman at Fort St. James carefully scrapes the flesh and hair from a moosehide before tanning it.

FIG. 84.—A Carrier girl and two boys at Fort St. James face the camera with only slight misgivings.

FIG. 85.—Rocher Deboule Mountain, towering behind Hazelton, is characteristic of the mountain scenery along the lower Skeena River.

FIG. 86.—Carrier Indians from Hagwilgate Village stand on this precarious scaffold to harpoon salmon in the torrent of the Bulkley River.

a great number of fur-bearing animals, the most important of which is beaver.

Most of the Carrier Indians live in small communities scattered along the lakes and rivers, but on the southern end of Stuart Lake they have a rancheria of several hundred persons which, with an equal number of whites, make up the village of Fort St. James. The "Fort," which is 42 miles north of the railroad at the end of an automobile road, is the last real outpost of civilization. Beyond it, one may travel for several hundred miles by boat along a chain of scenic lakes or, if hurried, he may even engage one of three sea planes that are stationed on Stuart Lake to serve the mines.

Fort St. James is nearly ideal from the anthropologist's point of view. Several hotels provide comfortable accommodations, and stores and trading posts afford essential needs. The Indians are friendly and intelligent, most of them speaking English fluently, and many are excellent informants. An ideal informant was found in Chief Louis Billy Prince, grandson of the great Chief Kwah who died 100 years ago, and acknowledged leader of the Stuart Lake Carrier. Physically vigorous, long of memory, and keen of mind at 76, his talents included not only a remarkably detailed knowledge of his own people but a reading knowledge of English, French, and the old Carrier syllabary taught him two generations ago by the missionary Father Morice. For 2 months the Chief answered questions about the past and present Carrier ways of living. When his information faltered, we always found another person who could fill gaps or verify statements.

After the data supplied by Chief Louis Billy were analyzed, it was possible to reconstruct a coherent picture of the main social and economic changes during Carrier history.

The Carrier Indians have always been hunters, trappers, and fishermen, living in reasonable security if not in affluence. They hunted with bows and arrows, nets, and traps, took salmon with weirs, and caught fur-bearing animals with a variety of ingenious devices. Originally, they had exploited their lands in some communal manner. Probably the members of a simple, democratic band hunted their territory together. But in late prehistoric times influence from the Pacific coast tribes swept away this early system and introduced in its place an organization of titled nobility, each with its lands like the baronial estates of Europe. By a system of clans with descent through the mother's side of the family, each wealthy aristocrat bequeathed his lands and title to his sister's son. It was not sufficient, however, merely to inherit riches and social status. In order to gain

FIG. 87.—Tsimshian Indians at Kitwanga on the Skeena River keep their totem poles in fresh paint for the enjoyment of passengers on the Canadian National Railway who stop over to view them.

FIG. 88.—Grave stones at Hazelton reveal how totemism and Christianity have blended to form the modern Tsimshian religion.

recognition as a full-fledged noble and to make good a title one had to give a large feast, called a potlatch, at which he lavishly bestowed presents on rival nobles. Like our own "social set," the Carrier aristocrats constantly jockeyed for rank by a succession of potlatches at which they sought to prove their superior wealth. The common people were merely auxiliary to this system. They were entitled to hunt on the land of certain noblemen, who were perhaps their own clansmen, but they were always liable to sizable levies when the nobleman needed goods to potlatch.

The Carrier had changed from a system of bands to one of a stratified society based on wealth without any modifications of their economic basis of life. The first effect of the coming of the white man was an improved economic technology, but the social organization was not affected. The fur trade established in 1806 brought steel traps, guns, tools, and manufactured goods given in exchange for furs. The Carrier nobles became richer and their potlatches more pretentious.

In the course of time, however, white influence directly and indirectly undermined the old Carrier society. The improved technology that at first produced greater wealth soon led to overexploitation of animal resources, with a diminution of wealth and consequent difficulty in potlatching. Meanwhile, the Catholic missionaries, who arrived in 1842, effected a remarkably thorough conversion of the Fort St. James people. Clan totems were overthrown, clans fell apart, and potlatching was regarded as a barbarism. The virtue of saving supplanted the glamour of giving presents. Men refused to will their hunting lands to their nephews and divided them equally among their own sons. Titles, formerly inseparable from lands, were confused by this new system of inheritance. Moreover, nobles, lacking wealth with which to potlatch, fell into disrepute. By the beginning of the present century nearly every Carrier had his own land and used it exclusively to support his own family. In 1926 trap lines were registered with the British Columbia Provincial government.

Today the Carrier Indians continue to live mainly from resources of the forests. As in days of old, they set out each fall with dog sleds or pack dogs to their trap lines. But with steel traps and modern rifles there is constant temptation to overexploit, a matter of no little concern to Provincial officials. In addition to furs, which are exchanged at the trading posts for manufactured goods, the Carrier sell moccasins and bags of moose hide, prepared and tanned in the native manner (fig. 83). The salmon catch has greatly decreased because the law forbids construction of fish weirs and because down-

FIG. 89.—Mr. Bransford becomes acquainted with one of the first Alaskans. The mummy box lies undisturbed in the background.

FIG. 90.—The mummy arrives safely at Ketchikan after flying 150 miles on the pontoon.

stream canneries have reduced the annual runs. But fish are still taken with nets, now woven of machine thread, and with steel hooks and flies. Fishermen ply the lake in dugout canoes which are frequently powered by outboard gasoline motors. A few men are beginning to build planked boats after the white man's models.

Except for their continued reliance on hunting and trapping, the Carrier are scarcely distinguishable in material culture from many of their white neighbors. Log cabins have replaced their ancient bark houses and are furnished with beds, tables, chairs, and stoves. Metal pots and pans are standard kitchen equipment, although excellent birchbark vessels are still made for home use as well as for trade. Clothing comes from the store. Moccasins are still popular, but rubbers are worn over them in wet weather.

In social features the Carrier are little different from the white man. Native songs, dances, and folklore, though surviving to some extent in neighboring communities, have practically vanished. The Indians regularly attend the Catholic church. Each morning my informant walked 4 miles to mass and returned home before my arrival. The Carrier language is spoken by all Indians but the syllabary is known only to a few old men. Others read and write Carrier with English letters learned at school.

Word having come of an Indian mummy that needed rescuing from an island west of Ketchikan, Alaska, I continued on to the coast. A brief visit was made to the Carrier and Tsimshian Indian villages and fishing stations (fig. 86) near Hazelton. The Tsimshian, living on the lower Skeena River, have a full-fledged totemic art that still may be seen on the totem poles at Kitwanga (fig. 87) and on the totemic grave stones (fig. 88) in the Hazelton cemetery.

From Prince Rupert, the railroad terminus on the coast, I went by steamer to Ketchikan. Lloyd Bransford, of the United States Forest Service, who discovered the mummy site, kindly accompanied me on a trip to recover the burial materials. We chartered a seaplane and, in an hour and a half, flew the distance that would have required several days by boat. We found several box burials (fig. 89) of the early historic period. One of the bodies was excellently preserved, probably because of desiccation. It was an adult male, dressed in buckskin and wrapped in a woven cedar bark blanket, his hair braided into many small queues and daubed with red paint. Without disturbing him, we removed his box, a coffin of adz-hewn cedar planks inlaid with shell, to the plane. As it would not fit inside, it was lashed to a pontoon (fig. 90) where it rode dizzily back to Ketchikan.

A FIELD COMPARISON OF NORTHWESTERN WITH SOUTHWESTERN INDIANS

By JOHN P. HARRINGTON
Senior Ethnologist, Bureau of American Ethnology

At the beginning of the calendar year I was engaged in field work on the Indians at Juneau, in southeastern Alaska, where the language was found to be surprisingly similar to that spoken by the Navajos, the largest tribe of Indians in the southwestern United States. The closeness of the resemblance extended both to the vocabulary and to the grammar, and is unique considering the great distance between the two localities—Juneau is 1,200 miles north of Seattle, Wash., and the Navajo Indian Reservation is about as far south of Seattle. The Navajos, or at least that section of their ancestors which imposed the language on the rest, must have come from what is now Alaska or the adjacent part of what is now Canada only a few centuries ago; otherwise there would be more difference in the Indian languages spoken. The Indians of the entire archipelago of which southeastern Alaska consists are known as "Tlingit." A hundred years ago they numbered some 10,000 souls, occupying all the islands of southeastern Alaska and subsisting largely on marine products, especially fish. About 400 words were collected in Alaska, almost identical with Navajo.

It will be evident to the reader that Indians living in such very different habitats and talking the same language must apply the same words to different objects. This proved to be the case. The word that among the Navajo means "cactus" means in Alaska "crab-apple," a bush with spines about an inch long; the fundamental meaning of the word is evidently "spiny." To the Navajo, living in the desert, fish is little more than a word. In Alaska fish is the livelihood and chief food of the Indians. The same word for fish is used in both regions.

The early spring proved to be the time when most animals and plants are advantageously collected in Alaska, and long experience has proved that the only safe way to get the Indian names of animals and plants is to collect the specimens with the help and interest of Indian informants and thus to get specimen and name at the same time. Figure 91 shows the author collecting a sea worm; the picture does not show the Indian who was standing nearby and giving the Indian name for a specimen collected in situ.

FIG. 91.—The author finds a sea worm and records the Indian name for it as given by the informant who accompanied him (not shown in the picture).

FIG. 92.—View of Sitka (meaning "Baranov's oceanward side"), showing Edgecumbe Peak in the background.

FIG. 93.—Alaska beach strewn with driftwood.

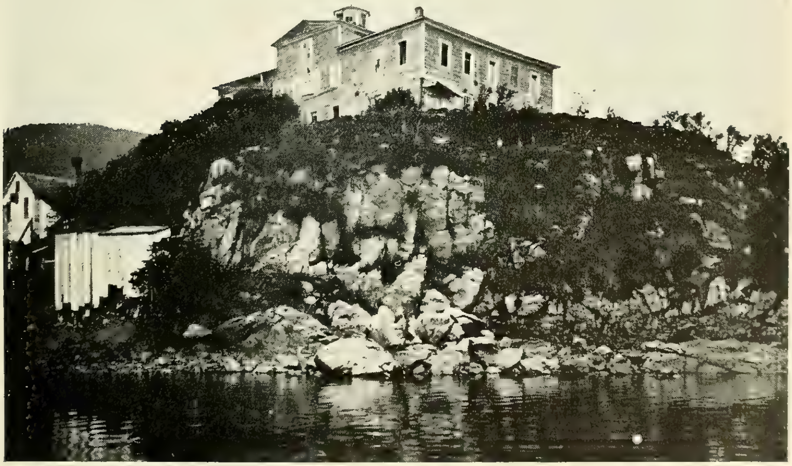

FIG. 94.—Baranov palace, headquarters of the former Russian governors, Sitka.

The location of "Ankau," one of the earliest of the Russian colonies in Alaska, has never been exactly known. It was my good fortune to locate it, through Indian information. It is on Ankau Inlet, which runs into Monti Bay, Alaska.

The origin of the name "Sitka" was discovered. It means "on the oceanward side of Baranov Island," and this is a good description of the location of the town. Shee, from which the first syllable of Sitka is corrupted, is the native Indian name of Baranov Island. -tka is a suffix meaning "on the oceanward side of." The town and its little islands are on the seaward side of the great Baranov Island and look out upon the great Pacific (fig. 92).

One of the impressive sights in Alaska to one who has heard old Indians tell of the early condition of United States beaches is the driftwood still piled high and unmolested by seekers after firewood (fig. 93). These driftwood beaches have the primitive aspect. Even on the coast of Oregon and Washington, driftwood is now removed at once from the ocean beaches by local settlers who use it as firewood.

Returning to Washington, D. C., in July, I left early in August for Gallup, N. Mex., for the purpose of checking the northern material with Navajo information. The Navajo language resembles the Tlingit language of Alaska word for word and syllable for syllable as much as peas resemble one another in the same pod. The words and the accounts of the Alaska customs fascinated the old Navajos, and there was little in the information from the far north that they did not see through and add analysis to. Motion pictures taken in Alaska were shown to the Navajo Indians both at Window Rock and at Fort Defiance, Ariz., to the keen delight of the native audiences. The Navajo have a tradition that ages ago some of their people became separated from the rest and went north and are known in the Navajo language by a term which is well translated as the "Again-Navajo." The Alaskan and Canadian Indians who talk like Navajo are identified with these "Again-Navajo." The news has spread through the great Navajo Reservation that the "Again-Navajo" have been located and visited, and interest in the comparison of words and customs is keen among the Indians themselves. Good informants and interpreters were found in southeastern Alaska and especially on the Navajo Reservation, where not only the Alaska material but the grammar of the Navajo language with all its ethnological connotations was completely gone through. I returned from the Navajo Reservation to Washington, D. C., in the middle of November, and by the end of the calendar year more than half of the entire material had been elaborated into the form of a finished report.

MUSEUM AND FIELD STUDIES OF IROQUOIS MASKS AND RITUALISM

By WILLIAM N. FENTON

Associate Anthropologist, Bureau of American Ethnology

Early in May 1940 I returned to my Seneca friends on Allegheny River in southwestern New York to learn more about the grotesque wooden false-faces and the rituals of the fraternity known as "The Society of Faces," which, among the Seneca and their Onondaga and Cayuga confederates along Grand River in Ontario, semiannually puts on the wooden masks and drives sickness from the community. The masks and the rituals differ somewhat locally, and the problem was to establish, through a study of carving techniques and finished masks, local artistic styles, and then to arrange the masks in a series of types according to their form and function. There was the further intriguing problem of determining whether the native classification would confirm or differ from a classification based only on formal features of specimens already present in our museums. Consequently, field interviews were combined with a project of studying Iroquois masks and ceremonial equipment in nearby museums.

At the New York State Museum in Albany, through the courtesy of the director, Dr. Charles C. Adams, and the kind cooperation of the State archeologist, Noah T. Clarke, the Morgan and large Converse collections were measured, annotated, and photographed. The small mask collection of the Montgomery County Historical Society at Fort Johnson was included. At Toronto we received many kindnesses from Prof. T. F. McIlwraith while examining the Boyle and Chiefswood collections from Grand River in the Royal Ontario Museum of Archaeology. At the Rochester Museum of Arts and Sciences Dr. Arthur C. Parker, while culling out the older Seneca masks for me, recalled from his field experience following 1905 at Cattaraugus some mask-making techniques that confirmed evidence I had noted in the older masks that they were burned out. We drove through the early historic Seneca town sites to the Bristol Hills, and our conversations lasted far into the night at "Rumpus Hill," my host's retreat above the head of Canandaigua Lake near the traditional homeland of the Seneca. A part of the enormous collections of the Museum of the American Indian was examined at the annex during one day, but the remainder merits another visit.

FIG. 95.—Chauncey Johnny John, of Coldspring, exhibits a turtle rattle and typical Seneca mask with flare lips worn by the doorkeeper of the Society of Faces.

FIG. 96.—George Buck, lower Cayuga of Grand River, points out the peculiar features of local art style: the bent nose and crooked mouth augmented by many wrinkles in likenesses of the first medicine man.

FIG. 97.—Drawing the features of the face before carving.

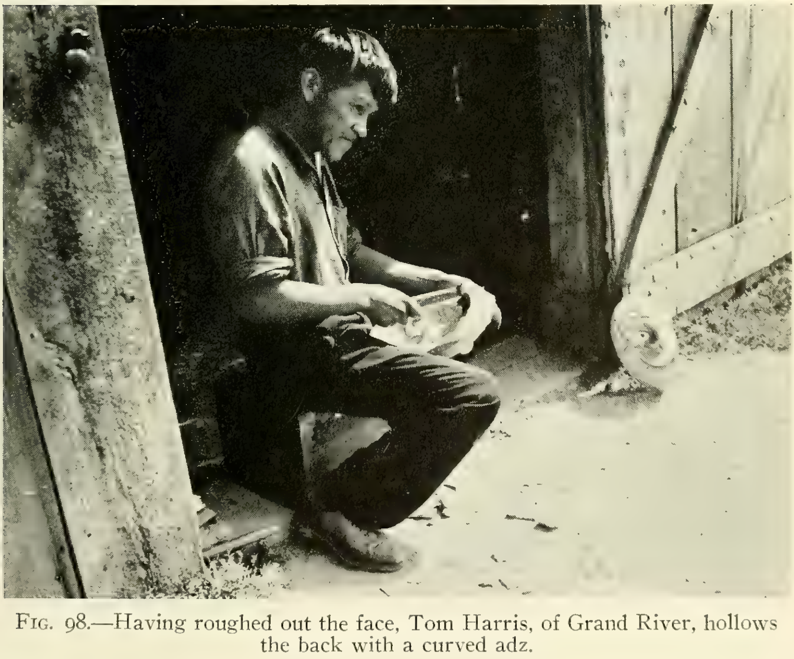

FIG. 98.—Having roughed out the face, Tom Harris, of Grand River, hollows the back with a curved adz.

We already had a wealth of material for use in the field, and the 200 masks we had seen were beginning to bother our sleep. The data included a selected series of criteria such as color, form of various facial features, presence of supplementary wrinkles and spines on the forehead, number of holes and method of attaching hair and head bands, and such evidence of use as oiling, ceremonial tobacco bags, and hints as to old carving techniques. Photographic prints were mounted with the notes for field use.

Informants regarded these pictures with mixed feelings. They were at once interested, a little awed, and amused. Intentionally horrific portraits are both awful and funny, and laughing relieves the tension of fear. When a mask provides an excellent caricature of some local personality, it becomes a great joke that so-and-so resembles a False-face, and a friend passing on the road is hailed in to share it. Chauncey Johnny John, of Coldspring, and James Crow, of Newtown, mask makers to the Seneca for a generation, segregated the pictures into a dozen mask types based on the most variable feature, the shape of the mouth. This feature plus the general treatment of carving frequently enables an informed Iroquois to name the local group and often the maker of the mask. The most characteristic masks from the Senecas of Newtown on Cattaraugus Reservation vary between "spoon-mouthed" and "straight-lipped," with smooth facial features broken up by a row of spines above the nose dividing wrinkled brows (fig. 95). Masks from the Onondaga of Grand River are more massive and have bent noses and crooked mouths augmented by many supplementary wrinkles (fig. 96).

Observation coupled with photography is particularly rewarding in studies of material culture, of which mask making is a good example. At Coldspring, Chauncey Johnny John undertook to make a mask for me according to Seneca standards, and so I recorded the steps commencing with a standing basswood tree, selected for straightness, from which he took the block and carved the mask in a series of stages of roughing out the face, hollowing the back with adz and crooked knife, and drilling the perforations with a hot iron (fig. 97). Anciently, masks were carved on the living basswood tree and cleaved away with a tobacco invocation beseeching the tree for its life, after which, it is said, the wound healed over. But now carvers prefer old pine barn beams. Similarly, we recorded the technique of manufacturing a folded hickory bark rattle.

While I was at Grand River during August, Tom Harris finally consented to demonstrate the carving of a crooked-face mask, although he said that it is not quite right for people to watch because there is

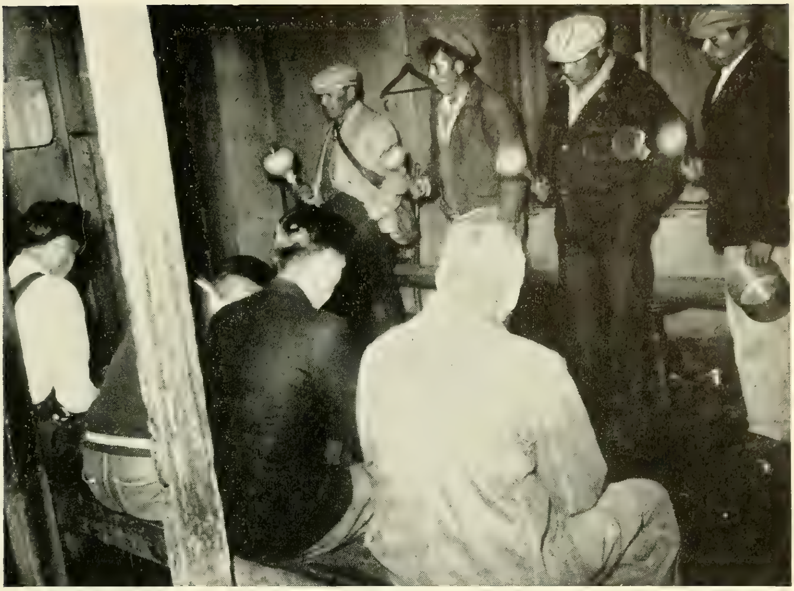

Fig. 99.—The Raven leads the members of the cousin clans over the forests to sing across the fire from the "brother clans" of the sponsor. Photograph by R. B. Congdon, Salamanca, N. Y.

Fig. 100.—Mr. Hilton Hill, of Six Nations Agency, Mrs. Fenton, and Mrs. Hill before St. Paul's chapel of the Mohawks on the site of Brant's first settlement on Grand River.

a belief that the carver may cut himself. Nevertheless, Harris is master of his tools and his strokes are sure so that within a few hours he had turned out two representative stages of the hadu'ʼi' mask for the National Museum (fig. 98).

Not only did my Seneca friends assist me in photographing their masks, but they readily posed themselves in the crucial stages of the masked rituals. Before long I was requested to help buy meat—a pig head and side pork that has supplanted bear meat in feasts—to help my interpreter's sister sponsor the rare ceremony of "They are cutting through the forests," hadi'hadi·ya's, to renew her membership in the Medicine Company. This ceremony, which is first mentioned by Jesuit missionaries among the Huron, is still kept up by the various lodges of the Iroquois Medicine Company. Giant Raven, the messenger of the Society, had in a dream descended on the roof of the sponsor's city home, and a clairvoyant had divined that this ceremony would help her. So she distributed a sacred eight kernels of corn to the Raven of her four clans, who transferred half to the Raven of the cousin clans. The whole responsibility for conducting the ceremony rests with the latter, who leads his gourd-shaking singers in through the woods from a neighboring house, and they enter and sit down across the fire from the brother clans of the sponsor (fig. 99). This dual division permeates the whole ritual from mutual greetings, the tobacco-burning invocation to the supernaturals, tossing songs across the fire, passing the berry juice between periods, curing the sponsor, the round dance, the masker's entrance, to the terminal feast. Thanks to Hiram Watt and Chauncey Johnny John, the Ravens, my friend Richard Congdon of Salamanca, who helped with the photographs, and Sherman and Clara Redeye, my interpreters, our files contain a complete record of the performance.

Smithsonian exploration and field work has become almost a tradition among the Six Nations near Brantford on Grand River. Once more we reaped the benefits of Mr. Hewitt's fine relations with the Indians and Canadian government officials. To Maj. E. P. Randle, Superintendent of the Six Nations, and Chief Clerk Hilton Hill (fig. 100) we acknowledge the fine facilities of a schoolroom study and teacher's residence among the Lower Cayuga. Here, throughout August our family was part of the Iroquois community while Simeon Gibson patiently outlined the yearly cycle of ceremonies at Onondaga longhouse and dictated the principal texts which make up the 9-day Midwinter Festival of dream fulfillment at the Indian new year. These ceremonies involve some vexing problems of social organization—the existence of village bands, the function of moieties, the nature of residence after marriage, and the sorrorate.

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